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## The professional development of beginning teachers of primary mathematics

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# **The professional development of beginning teachers of primary mathematics**

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Thesis submitted in fulfilment of the requirements for  
the degree of Doctor of Philosophy, Edith Cowan  
University

Faculty of Community Services, Education and Social Sciences

September, 2000

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# Abstract

Recent documents have recommended a style of teaching for primary mathematics classrooms that favours a constructivist viewpoint of learning. The actuality of many mathematics classrooms is different from this vision. Newly trained teachers while exposed to, and expounding, a constructivist philosophy are, in many cases, implementing a more traditional, teacher-centred approach to classroom practice.

The purpose of this study was twofold: to investigate factors which influence the pedagogical practices and beliefs of beginning teachers of mathematics in primary classrooms, and secondly to evaluate a professional development support model for beginning primary mathematics teachers. A model for professional development and support of beginning teachers of primary mathematics was designed from critical characteristics of effective teacher support obtained from the literature. The model was designed via the use of a 'fellow worker' to help beginning teachers implement constructivist ways of teaching mathematics in their classrooms. It was implemented over a period of the first year of teaching for the five participants.

The research took the form of an interpretative, qualitative study. The main methods of data collection were interviews, observation, researcher and participant journals, case methods meetings, repertory grids, RADIATE categories, pre and post questionnaires and characterisation scales. Data were analysed using techniques of qualitative analysis recommended by Eisner (1991) and Miles and Huberman (1994). Analysis incorporated the use of the NUD\*IST computer program.

Findings suggest that the professional development, support model was successful in helping beginning teachers implement and sustain a more constructivist philosophy in mathematics teaching. It appeared to provide an effective framework to meet the individual needs of teachers within specific contexts. It was an effective alternative to the



isolation and 'sink-or-swim' attitude of the first year of teaching felt by the participants. Beginning teachers used reflection in their teaching and generally began to implement less teacher-directed, traditional methods of teaching after emerging from a foreshortened 'survival' period.

The major influences acting on pedagogical practices were the children in the classrooms of the beginning teachers. Other factors such as limited pedagogical knowledge, traditional ways of behaving as a teacher, beliefs about mathematics, mathematics teaching and learning, and time also influenced classroom practice in primary mathematics.

The major finding of the research is that, with personal and context-specific support, beginning teachers can start to implement pedagogical practices in primary mathematics consistent with recent recommendations. This thesis recommends that the support must come from both the general system and the school levels and must address the needs of the individual teachers rather than mass induction methods. Distinction and separation must be made between beginning teacher support and the assessment of the beginning teacher's competence. General methods involving a 'sink-or-swim' philosophy and beginning teacher isolation should be abandoned.

At the conclusion of this thesis, recommendations for further study and research are provided.

## Declaration

“I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution in higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.”

Signed:

Date: *September 2000.*

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# Chapter One

## Introduction

### Background to the study

The Discipline Review of Teacher Education in Mathematics and Science (Department of Education, Employment and Training, 1989) noted that there was a mis-match in many cases between what was taught in teacher education courses and what subsequently evolved in primary school classrooms. Recommendations of the *Curriculum and evaluation standards for school mathematics* and the *Professional standards for teaching mathematics* documents from the National Council of Teachers of Mathematics (NCTM 1989; NCTM, 1991) and *A national statement on mathematics for Australian schools* (Australian Educational Council, 1991) have posed a view of mathematics teaching and learning which, in most cases, differs from that which teachers and, in particular, beginning teachers currently undertake in primary classrooms. More recently, this view of mathematics as more than a collection of facts and skills has been endorsed by the *Curriculum Framework* (Curriculum Council of Western Australia, 1998) and *The Student Outcome Statements for Western Australian Schools* (Education Department of Western Australia, 1998). Many factors have influenced these documents, in particular the pressures for change to meet the needs of the workforce for the twenty-first century, the inclusion of ever-developing technology of powerful computers and calculators, new insights gained from research into how children learn, and changing perceptions of what it means to know and do mathematics. The documents expound a view of mathematics and also mathematics teaching and learning based on research findings and the subsequent use of these findings to underpin effective classroom practice in primary mathematics teaching.

In recent times the quality and status of the teaching profession have been a concern of governments in a number of countries, for example the Teacher Training Agency in the United Kingdom and the Australian Teaching Council. These bodies have developed sets

of professional standards that clearly state what a competent beginning teacher should know and be able to do (Gill, 1998). It is against this background of concerns about beginning teachers and the apparent mismatch of mathematics teaching that this study was undertaken.

## **Recommendations for classroom practice in mathematics**

The mathematics classroom envisaged by recent documents is one where students are engaged in mathematical problem solving, reasoning and communication. Learning is accomplished in the context of small group and whole class settings in which teachers assist students to build their own understanding of mathematics. Such an environment is intended to encourage students to assume more responsibility for their own learning.

In order to understand the need for change in mathematics teaching one must first consider why many people feel traditional mathematics is inappropriate for children. Aspects of a traditional approach are criticised by Anderson and Piazza (1996), who claim such teaching methods lead to learners who are dependent on authority, are unable to solve multifaceted, higher-level mathematics problems, are competitive rather than collaborative and engage students in limited knowledge construction.

Brooks and Brooks (1993) have offered several criticisms of the traditional classroom, which may lead to the restricted outcomes noted earlier:

- teachers talk too much;
- teachers rely too much on textbooks;
- most classrooms discourage cooperation and force students to work alone on lower order skills;
- student thinking is not valued; and
- schooling has, as an underlying premise, the behaviourist idea that one external reality exists which all students should come to know (p. 26).

In contrast, current official government documents and advice from professional organisations for classroom practice present recommendations exemplified by the following reports.

From the United States, the *Curriculum and Evaluation Standards* (NCTM, 1989) outlined five goals for all students:

- that they learn to value mathematics;
- that they become confident in their ability to do mathematics;
- that they become mathematical problem solvers;
- that they learn to communicate mathematically; and
- that they learn to reason mathematically (pp. 5-6).

Simon (1994), noted that this vision of mathematics teaching in schools “represents a radical departure from traditional mathematics classes” (p. 72).

In the United Kingdom the emergence of the National Curriculum— *Mathematics in the National Curriculum*, (Department of Education and Science, 1991)— has seen similar views of mathematics expressed. This followed from the earlier directions of the Cockcroft Report (Department of Education and Science, 1982) that mathematics could be seen more in terms of general processes or ways of thinking, such as communicating.

In Australia, *A national statement on mathematics for Australian schools*, (AEC, 1991), used the idea of Steen (1988) to present mathematics in the following way.

Mathematics is often defined as the science of space and number...[but] a more apt definition [is that] mathematics is the science of patterns. The mathematician seeks patterns in number, in space, in science, in computers, and in imagination. Mathematical theories explain the relations among patterns. ...Applications of mathematics use these patterns to explain and predict natural phenomena ...(p. 21).

The implication of these recommendations and goals is that a different classroom environment from that which has come to be called ‘traditional practice’ is required. The classroom needs an image of a teacher as a facilitator or guide to learning, “helping students learn to seek imaginative solutions to problems in constructive ways”(p. 21). The complementary image is one of students being actively involved “experiencing the reward of arriving at a solution through their own initiative and persistence and not simply through imitation (AEC 1991, p. 21). Learning mathematics is seen as students constructing ideas and building their mathematics based on active, challenging experiences (von Glasersfeld, 1995).

Recommendations for classroom reform and pedagogical practice have been consistent over a number of years (McIntosh, 1979). The recommendations presented at this time are adding a constructivist perspective to those long-held views. What evidence of classroom practice is there and how consistent with the recommendations of the experts and documents is it? The next section will briefly consider that comparison.

## **The reality of classrooms**

Teachers, on the contrary, often do not work in these recommended ways. The Third International Mathematics and Science Study (TIMSS) noted that teachers generally continue to keep their teaching approaches to traditional methods (Lokan, Ford & Greenwood, 1996). They tend to view mathematics as a fixed body of knowledge that is best learned by memorising facts, rules and procedures for applying them to text book exercises. They view the role of the teacher as carrying out goals determined by textbook material, providing demonstrations and examples of tasks to be completed and checking books for completion and accuracy (Wilcox, Schram, Lappan & Lanier, 1991). Research by Aguirre, Haggarty and Linder (1990) found that fifty percent of pre-service teachers in their study held the conception that “teaching is a matter of knowledge transfer from the teacher’s head and text books into the empty minds of children” (p. 382). This offers a simple conception of the child as an empty vessel ready to be filled with knowledge provided by the teacher. In the United States, conventional mathematics instruction has long placed an emphasis on memorisation and imitation rather than understanding, thinking, reasoning and explaining (Brown, Stein & Forman, 1996). Much time was devoted to recitation and seatwork. Generally there was little or no student interaction or individualisation of the work set (Stodolsky, 1989). While the picture may not be as extreme in Australian classrooms, much mathematics time is given to individual completion of photocopied worksheets and textbook pages. McIntosh (1979) commented that educators have learned little from the past one hundred and fifty years with regard to effective teaching as recommendations from reports and research appeared not to have been implemented into classrooms. The same can be said to be true in many classrooms over twenty years later. Reports, recommendations and research have not impacted greatly on pedagogical practice and consequently have not broken the ‘cycle of tradition’.

There are a number of reasons why this is the case. One important one is the apparent ineffectiveness of teacher education courses. Pre-existing beliefs and images about teachers and teaching seemed to play a central and significant role in filtering the content of education coursework during the teacher education period, and in some cases negated any effect the training period might have had. This is clearly noted in Kagan's (1992) review of research and by Calderhead and Robson (1991), McDaniel (1991) and Weinstein (1990).

The research project detailed in this thesis planned to identify factors which may cause this possible mismatch between training, recommendations and practice. A framework of support was devised for beginning teachers so that they might establish effective, research-based methods of teaching and learning and overcome the possible mismatch. The support programme was evaluated. The project attempted not only to support beginning teachers in their survival of the induction year but also to break the 'cycle of practice'. It did this by helping teachers reconceive their role, from that of dispenser of knowledge to facilitator of learning, bringing it more into line with informed recommendations and closing the gap between research and practice. A constructivist approach was used to provide professional development and support. The project was established in the context of working with five beginning teachers of primary mathematics.

Specifically the aims of the project were to:

- describe beginning teachers' emergent knowledge, beliefs, thinking and action related to teaching mathematics in the primary school,
- examine the impact of a professional development support model on the process of learning to teach mathematics in the first year of teaching,
- understand the interdependence and mutual influence of components of teaching and learning to teach,
- understand the nature of a learning environment and the ways in which beginning teachers interact with it.

## **A constructivist perspective**

In the context of children as learners, the Australian Education Council favoured a constructivist viewpoint “that learners construct their own meanings from, and for, the ideas, objects and events which they experience” (AEC, 1991, p. 16). This reported project has also taken a constructivist perspective in its design for interaction with beginning teachers, following the Australian Education Council recommendation and findings from recent literature. A positivist view that meaning can be passed from teacher educator or others to a learner teacher was rejected by Richardson (1996) in favour of an approach which allows and helps teachers construct their own knowledge about teaching. The project used an approach with beginning teachers, which mirrored the one outlined for the classroom for use with children. It has been suggested that teachers experience continuous growth as they learn to teach through their own construction of knowledge, which develops and evolves through sustained conversations during their first year of teaching (Hollingsworth, Dybdahl & Minarek, 1993).

Treagust, Duit and Fraser (1996) consider constructivism, particularly some of its strengths, namely its potential for informing practice and the variety of ways in which it can be interpreted, as providing a plausible, functional framework for understanding and interpreting experiences of teaching and learning. Constructivism, however, is open to different of interpretations. But, regardless of the range of views about constructivism, there is no doubt that the constructivist viewpoint has been a productive influence on research. Even critics of a constructivist view (Matthews, 1993; Solomon, 1994) admit that this perspective has aided researchers and curriculum developers. As might be expected, critics of constructivism take different positions. They tend to be centred about four issues: Constructivism is simply common sense; it has epistemological flaws; it leads to denial of the existence of the physical world; and excessive focus on the individual does not take social issues into account. The criticism of constructivism, mainly of a philosophical nature, is that it is not necessarily a perfect answer to improving teaching and learning. Even acknowledging the critiques noted briefly above, the constructivist view still allows a consistent explanation of findings.



Beginning teachers undergo a difficult transition from university study with limited practical training to professional practice. They assume total responsibility for a classroom, which includes the instruction, motivation and discipline of students, assessment and interaction with parents. They have no more than a teaching qualification, often unrealistic performance expectations and a few weeks of student teaching, which in many cases bears little resemblance to the everyday reality of full-time teaching (Johnson, Ratsoy, Holdaway & Friesen, 1993).

Following from a constructivist viewpoint that learners construct their own meaning from their experiences and that teachers grow in their understanding of teaching in similar ways, a professional development model was designed to support beginning teachers. The model used a constructivist philosophy of working to support teachers in their growth as professional educators. It was designed to support teachers in the difficult first year of teaching and also with a view to encourage pedagogical practices that moved on from traditional methods.

There is already some work reported in this area, for example, Brickhouse and Bodner (1992) studied how typical beginning teachers adapted when confronted with difficulties. They concluded that the beginning teacher was struggling to reconcile conflicting conceptions between what is desirable and what is possible with the constraints of preparation and the work situation. During this process of reconciliation children's reaction was an important constraint on the beginning teachers' conceptions and behaviours of teaching (Cooney, 1985). Rust (1994) also concluded that new teachers are strongly affected by the conditions of the workplace. The results of these studies revealed teachers' conceptions and beliefs are likely to be influenced by students and working conditions. Lin (1996) noted:

It is therefore, of particular interest to check what changes in beginning teachers' conceptions of teaching have occurred during one year... (p. 17).

As well as identifying the beliefs held by the sample teachers, the study monitored the development of these beliefs to see if they were maintained and strengthened, especially if they were supportive of recommendations for pedagogical practice. Influences emanating from the school context were identified and a model of support and

professional development for beginning teachers and their mathematics teaching was designed, implemented and evaluated. This project has used the framework of the studies noted earlier to establish background information on the beliefs of beginning teachers. It has then tracked a small sample of them into the first year of primary school teaching to identify what influence these beliefs and attitudes may have on actual classroom practice. Although several models for inservice or professional development have been adopted for experienced classroom teachers (Clarke & Hollingsworth, 1994) very little research has been directed towards the development of appropriate models for novice teachers in primary mathematics classrooms. This is one aspect of the significance of this study. Further aspects of significance will be discussed in the next section.

### **Significance of the study**

Following from the brief account given above there seems to be an implicit problem with the mathematics education being offered to children in the present school system. Curriculum documents outline a mathematics education based on the needs of society in the twenty-first century, a technological understanding and application of mathematical knowledge. Many children, however, encounter an education more suitable for an outdated perception of society's needs, one more appropriate to a former industrial rather than a modern information-based society. It could be argued that a change in teaching style, belief and philosophical outlook is needed to address this situation.

Reviews of the literature (for example, Feiman-Nemser, 1992; Kagan, 1992; Reynolds, 1992) have suggested that our knowledge of how people learn to teach has expanded to give a broad understanding of what happens. Aspects of the learning-to-teach picture, however, remain unclear with some studies appearing contradictory, some suggesting that it is a simple, skill-based process while others point to a more complex picture (Wideen, Mayer-Smith & Moon, 1998). Further detail of this development and actual case studies of teachers are needed to offer clarity to the complex issue. This study will add to that needed detail.

In recent years researchers have started to consider and investigate attitudes and beliefs held by teacher education students with regard to mathematics and to the teaching of

mathematics (Ball 1988a; Ernest 1989; Nisbet 1991; Relich & Way 1992, 1994; Sullivan 1989a, 1989b; Thompson 1984, 1992). Thompson (1992) noted that studies that have direct practical implications are particularly valuable:

Insightful analyses and detailed accounts of how teachers internalise new ideas and develop new instructional practices can contribute to our understanding of the cognitive process involved in teachers changing their conceptions and practices (p. 140).

She continued:

We must explore ways to help teachers examine their beliefs and practices, develop intrinsic motivations for considering alternatives to their current practices and develop personal reasons for justifying their actions. For teachers, intrinsic motivation for considering alternatives must come from their own experience in the classroom (p. 143).

Wilcox, Schram, Lappan and Lanier (1991) have offered similar challenges to researchers, this time directly related to the beginning teacher.

How can we overcome the perceived contextual constraints that lead beginning teachers to fall back on more familiar and traditional practices once they have left the university for their own classrooms? What kind of support is needed in the induction years for teachers who would institute practices that are likely to be questioned in traditional school settings? ...These questions deserve our serious and continued study and our best efforts at creative solutions (p. 38).

This reported study is particularly significant in that it has investigated and has provided data to add to the shallow pool of information in this area. The study examined how beginning teachers experience the process of learning to teach primary mathematics. It tells the story of five beginning teachers, starting with who they are and the beliefs they bring to their programs, in an attempt to understand what they know, how that knowledge is acquired and how it is used in the classroom to teach mathematics.

This study has provided data for education professionals who have a responsibility for the training, induction and development of teachers. The findings offer a view of how beginning teachers use and respond to teacher education courses, school situations and induction, or lack of them, programs. While the literature provides information on beginning to teach little is available to schools and employing authorities to guide their induction process for newly trained teachers.

## Organisation of the thesis

The thesis begins with a review of the literature in Chapter 2 related to information known about beginning teachers and in particular about beginning teachers of primary school mathematics. It provides an overview of the important elements that characterise the experiences of beginning teachers. These elements provide the basis for the design of the professional development model as well as informing the later analysis of the data.

Further, it discusses factors influencing the classroom practice of teachers. One of the major factors identified from the literature is that of teacher belief about mathematics, mathematics teaching and mathematics learning. The other main factor influencing pedagogical practice is that of the context of the teaching. Both these factors formed a basis for the research questions of the study.

The next chapter of the literature search (Chapter 3) focuses on the variety of models of professional development and change for teachers of mathematics. From these models critical factors were extracted to form a model for the professional development and support of beginning teachers of primary school mathematics. The model was based upon constructivist learning principles.

Chapter 3 also provides a conceptual framework for the study that is based on the critical elements identified in the previous chapters. It provides a rationale for the professional development model and considers the notion of maintaining non-traditional beliefs and attempting to influence traditional beliefs about mathematics and mathematics teaching. It concludes with the Research Questions investigated by the study.

The research methods adopted by the project are described and justified in Chapter 4. Each method is described in detail and related to specific data gathering roles. The context of the study and the participants are also described. The chapter concludes with a note of ethical considerations and issues of reliability and validity of the research.

Chapters 5 to 8 present an analysis of the data and discussion of each Research Question for the project. Each chapter analyses the data at an individual beginning teacher level via a case study report of the participant. Each chapter discusses factors influencing their

pedagogical practices and beliefs about pedagogical practices, as well as the effect of the professional development and support model, during the first year of teaching.

Chapter 9 provides an analysis of the data from a combined perspective, combined in the sense that it highlights and synthesises themes, issues and dilemmas experienced by the beginning teachers as a group rather than as individuals. It leads into Chapter 10, which offers tentative conclusions and suggests implications arising from the findings for schools, university teacher education courses, beginning teachers and employing authorities. The chapter continues with a summary of the research, together with discussion of the limitations of the study and recommendations for further research.

## Chapter Two

### **Practices of beginning teachers: A review of the literature**

#### **Introduction**

In Chapter One the mismatch between the pedagogy suggested by expert opinion, research and recent policy documents and actual classroom practice was highlighted. It might be hypothesised that recently trained teachers would be more likely than long established teachers, to work in accordance with modern pedagogy. Is there a discrepancy or coherence between the performance of beginning teachers in the primary school mathematics classroom and the expectations and theoretical models of teaching and learning expounded by university education courses and recent documents on mathematics teaching? These expectations and recommendations are reported by bodies such as the Discipline Review of Teacher Education in Mathematics and Science (DEET 1989) and the Australian Council of Deans of Education (1998). Observations at an informal level suggest that there is discrepancy. Namely, that newly trained teachers, while being recently exposed to a more open, constructivist philosophy of mathematics in their teacher education course invariably return to a traditional role of teacher exposition and a transmission mode of teaching (Lacey, 1977; Rust, 1994; Sullivan, 1989a; Tabachnick & Zeichner, 1984). This is in spite of expounding a less traditional philosophy in their writing and discussions during their university course (Rust, 1994).

Beginning teachers undergo a difficult transition from pupil to teacher via university study. They assume total responsibility for a classroom, often a complex one, with a substantial teaching load. Despite a crucial need for support and guidance during this stressful time, many beginning teachers feel isolated, and have to adopt a sink or swim mentality to survive. This is a time of 'reality shock' and 'the adjustment phenomenon' which some do not survive (Veenman, 1984; Weinstein, 1988).

This chapter of the thesis will begin to discuss factors that appear to influence teachers' and beginning teachers' classroom practice and outline evidence for the discrepancy between these practices and teacher education course expectations. Evidence related to teacher beliefs and their influence on classroom practice, the effect of context, the experience gained from the university teacher education course and the beginning teacher's time as a pupil in mathematics classrooms, will also form part of the discussion in this chapter. Other relevant factors influencing the Research Questions and the theoretical framework (see Chapter 3) will also be considered. The discussion will start with a section, which highlights what is known about the practices of beginning teachers. The protocol adopted here, and in the following sections, will consider the evidence and findings related to beginning teachers in general, and then to beginning teachers of mathematics in particular.

## **Beginning teachers**

In a comprehensive analysis of the learning-to-teach literature, Reynolds (1995) found that beginning teachers, as a group, do not have all the understandings and skills expected of accomplished practitioners.

Specifically she found that beginning teachers have difficulty:

- seeing how student differences influence choice of pedagogy;
- implementing systems for classroom management, organisation and discipline;
- establishing relationships with students and colleagues; and
- explaining content material in ways that students can understand.

From interviews conducted about the first year of teaching, Gill (1998) constructed a complex picture of teachers' experiences. She produced a framework of areas of uncertainty (Table 2.1) which illustrated common preoccupations of teachers in their first year of teaching.

**Table 2.1 : The teachers’ framework: Areas of uncertainty (Gill, 1998, p. 101)**

1	Entry shock
1.1	Questioning the adequacy of teacher training preparation;
1.2	Doubt over ability to cope with workload;
1.3	Desire to be accepted by colleagues.
2	Time management
2.1	Perception that there is ‘never enough time’;
2.2	Concern over the impact of non-teaching, managerial issues;
2.3	Difficulty in achieving long term planning;
2.4	Anxieties about keeping up.
3	Class management, control and relationship with students
3.1	Under acknowledgement of classroom as a complex social site;
3.2	Preoccupation with discipline issues;
3.3	Ad hoc treatment of individual behaviour problems;
3.4	Excessive preoccupation with individual problem students;
3.5	Worry about managing the extremes of mixed ability teaching;
3.6	Limited understanding of custodial role.
4	Curriculum and pedagogical management
4.1	Disjunctions between content and process dimensions;
4.2	Excessive attention to ‘covering the work’;
4.3	Difficulties in monitoring student progress and managing assessment and reporting;
4.4	Anxiety over students’ results in common tests;
4.5	Overplanning and dependence on pre-packaged or other teachers’ materials.
5	Establishment of ‘teaching identity’
5.1	Uncertainty about professional image;
5.2	Difficulty in feeling part of the staff community;
5.3	Anxiety about being accepted by students, fellow teachers, parents;
5.4	Anxiety about asking for help;
5.5	Difficulty in reconciling managerial and pedagogical dimensions of school life;
5.6	Passive attitude to staff hierarchies and school decision making;
5.7	Limited awareness of socio-political aspects of schooling and professional life.
6	Retrieval and reconstruction of teacher training knowledge
6.1	Dependence on prior curriculum materials and lesson plans.

The major similarities between the two studies appear to centre in Gill's third section, that is classroom management, control and relationships with children. A simplistic image of teaching is suggested, one of the teacher telling and the teacher controlling children, by the beginning teachers. Gill's work noted the need for the beginning teacher to be seen as a 'proper teacher' and to be accepted into the teaching community. Both studies considered beginning teachers as a group. They offer no particular evidence for the difficulties and areas of uncertainty of beginning primary mathematics teachers.

One of the major concerns of beginning teachers is that of discipline (Ryan, 1974; Veenman, 1984). Ryan (1974) concluded, “there is probably no single thing that causes



beginning teachers more trouble and anxiety than discipline problems” (p. 11). Ryan also noted other factors of a general nature that caused beginning teachers difficulty. They included personal life adjustment, teachers’ expectations and perceptions of teaching, the strains of daily interactions and the teaching assignment itself. These difficulties lead to intense strain, to fatigue, to depression and for some, exit from the profession (Varah, Theune & Parker, 1986). Dowding (1998) made a similar point when he noted that “it is understandable therefore that the novice teacher will suffer from fear, anxiety, stress and feelings of inadequacy. And in most cases they face this traumatic period in isolation” (p. 18).

### **Developmental stages in the practice of teaching**

Research in Australia, the United Kingdom and the United States of America, has suggested that beginning teachers pass through a number of developmental stages from initial survival to the development of professional proficiency. This is regardless of the extent, nature and quality of their pre-service preparation (Board of Teacher Registration, 1991). Significant in the discussion of beginning teachers is the work of Katz (1972) and Burden (1982) on the stages of development in teachers’ careers. More recently Vonk (1989) and Huberman (1995) have added to the debate with their own versions of teacher developmental stages.

Katz (1972) outlined a model for teachers’ development, which consisted of four general stages:

- Survival—which lasts about one to two years;
- Consolidation—generally in the third year;
- Renewal—during the fourth year; and
- Maturity—extends through the fifth year and onwards.

Burden (1982) conducted a synthesis of work in teacher career cycles to produce a refinement of the teacher development model. Burden’s stages are:

- Survival—the first year;
- Adjustment—second to fourth years; and

- Mature—fifth year and beyond.

Both models noted the first year as a survival stage for the beginning teacher. Katz suggested this was a time for on-site, technical support to help teachers with their concerns about inadequacies related to classroom control, subject teaching and knowing what to teach. A point made by Veenman (1984) later when he argued that, during their first few years in the classroom and in their initial training, many teachers experience difficulties in learning to teach. They tend to focus on behaviour management, arranging the physical environment and preparing lesson plans and instructional material. Managing children, understanding subject matter, socialising into the school and community, monitoring children's progress and understanding, planning worthwhile activities are all common sources of difficulty and anxiety. It is this desire to survive by the beginning teacher which often sees them resort to practices and teaching behaviours which cause the learning environment to suffer (Huling-Austin, 1990). Beginning teachers become overly concerned with class control and shift the focus of activities from those designed to encourage and support learning, to those likely to discourage disruption (Kagan, 1992).

Further refinements of developmental models have been undertaken by Fessler and Christensen (1992) and Vonk (1989). The model of Fessler and Christensen, while similar to earlier ones, presented a dynamic view of ebb and flow resulting from the influence of environmental and personal factors. Their model questions the notion of a linear, step-like progression of earlier designs. Vonk's model of teachers' professional development based on his review of the literature offered the following framework:

- Pre-professional phase—initial education and training;
- Threshold phase—first year of teaching;
- Growing into the profession—second to seventh year;
- First professional stage;
- Reorientation;
- Second professional stage;

Vonk's threshold phase is concerned with developing teaching abilities and gaining acceptance by students, peers, administrators and the community. Both Vonk (1989) and

Huberman (1995) presented sophisticated, multifaceted views of teacher development cycles. They offered alternating, complex paths rather than the unidimensional views of Katz's earlier work.

Ryan (1986) described the initial stage of his four stage model of teacher development as the 'fantasy stage'. It is closely followed by the 'survival stage' in a way similar to other reported teacher development models. In Ryan's model the fantasy stage is just prior to the first year of teaching. It is in this stage that teachers see themselves as caring and loving and they consider students to be respectful and appreciative. A single event or a series of minor crises, however, can initiate the survival stage, which may last about six months. From here the beginning teacher starts to learn the craft of teaching—learning what tools to use in a given situation.

Similarly, Rust (1994) charted the growth of students' child-centred views of teaching and learning, often based on child care experiences, during their initial training programme. This child-centred view was followed by a reversal to more control-oriented beliefs about teaching when faced with the realities and practicalities of teaching in their first year of employment. There are also complex interactions within many beginning teachers which occur with their beliefs, values, teaching practices and the norms of the school in which they are teaching for the first time.

All models, however, noted the first year of teaching, the beginning teacher year, as being concerned with survival, acceptance into the profession of teaching and the development of classroom teaching skills. The developmental stages relating to the first year in school noted, as did Gill (1998) and Reynolds (1995), anxiety and teacher directed practices. Thus, the hallmark of thinking among competent teachers, a sense of the holistic nature of teaching, learning and life in schools, is not present in the beginning teacher (Reynolds, 1992).

If this is what many beginning teachers are like, what are the factors which are contributing to this image? The next section will discuss factors that influence the pedagogical practices of teachers and those of beginning teachers of primary mathematics in particular.

## **Influences on classroom practices of teachers**

Many of the general concerns, areas of uncertainty and stages of development noted previously are applicable to beginning teachers of primary school mathematics. While there appears not to be a simple cause and effect model in action, some of the concerns and anxieties tend to influence the pedagogical practice of beginning teachers. Well before the novices reach the first real classroom as beginning teachers, they have been influenced by personal beliefs and attitudes (Thompson, 1992), the context of work, (Simon & Brown, 1996), the university course, (Feiman-Nemser & Featherstone, 1992; Raymond, 1997), content knowledge, (Ball, 1988c; Shulman, 1986) and school experience as a student teacher and as a pupil. All combine to produce powerful, complex and idiosyncratic influences on the beginning teacher and subsequent classroom practice in mathematics teaching. This section of the discussion will consider specific evidence related to beginning teachers of mathematics in a primary school setting.

### **Beliefs**

No teacher is completely devoid of influences and experiences—the *tabula rasa* of earlier times. They are not without knowledge of teaching, classrooms and schools even when starting a university teacher education course. Beginning teachers respond to the workplace differently, depending upon entering beliefs and expectations (Richardson, 1996). These beliefs and expectations are shaped by experiences as students in school. They, in turn, influence significantly the ways in which roles are defined and undertaken. Beliefs tend to be formed early and tend to be resistant to change (Pajares, 1992). Carter and Doyle (1996) concur with this:

The act of teaching, teachers' experiences and the choices they make and the process of learning to teach are deeply personal matters inexorably linked to one's identity and, thus, one's life story (p. 120).

Generally teachers do not develop new perspectives but become more skilful at defending what they believe already (Wideen, Mayer-Smith & Moon, 1998). While many researchers have pointed to the major role played by teacher beliefs in determining classroom practice, the cumulative effect of other factors is also of importance (Raymond, 1997).

The next section will address each of the factors noted above, in particular the issue of teacher beliefs, and see how they impinge on the pedagogical practice of teachers and beginning teachers. The discussion will consider first teachers' beliefs and then examine other factors such as context for teaching, university training and experience as an influence on these beliefs and classroom practice.

## Belief — a definition

Before considering what it is that many teachers believe about mathematics and its teaching and learning in the primary school, it is important to clarify, in this context, what a belief is—to provide a definition. Ernest (1989) drew a distinction between two aspects of the psychology of teaching. First there are the teacher's thought processes, such as planning, decision making and reflecting, and second the thought structures of the teacher: the knowledge, beliefs and attitudes stored as schemas in the mind. Rust (1994) used the work of Sigel (1985) and O'Loughlin (1989) to define beliefs as:

Those socially constructed representational systems that people use to interpret and act upon the world (p.206).

In a further attempt to understand the idea of beliefs, Perry, Howard and Conroy (1996) cited Rokebach's earlier work, which defined a belief as:

Any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase: I believe that... (Rokebach, 1968, p.2).

Yet another variation on a definition of belief is offered by Southwell (1993) when she described a belief as, “ an idea which, when held, determines the way the individual acts” (p.293). From the prevailing definitions of beliefs, (Raymond, 1997) defined mathematical beliefs as:

Personal judgements about mathematics formulated from experiences in mathematics, including beliefs about the nature of mathematics, learning mathematics and teaching mathematics (p. 552).

The main aspect emerging from all of the definitions given above is that of action. Beliefs result in action and action in the classroom. The next section will discuss the

influence of teachers' beliefs on teaching strategies and classroom practice in mathematics.

### Beliefs influencing pedagogical practice

One of the factors, comprising three sub factors, which has been suggested as influencing classroom practices of teachers is that of the beliefs held by the teachers about mathematics, how one learns mathematics and how to teach mathematics (Van Zoest, Jones & Thornton, 1994). In recent years there have been a number of studies, usually at the pre-service level, which have tried to identify teacher beliefs (Ball, 1988c; Frid & Malone, 1995; Hollingsworth, 1989; Nisbit, 1991; Pajares, 1992; Relich & Way, 1994; Thompson, 1992). Beliefs are often grounded in school and college experiences, with memories of former teachers also playing a large part in their construction (Mertz & McNeely, 1991). Pre-service students have acquired a general understanding of the behaviours of mathematics teachers, which are usually based on their past school experiences and their pre-service teaching practice experiences. Lerman (1983; 1990) and Thompson (1984), for example, have shown that teachers' instructional practices are closely related to their beliefs about mathematics. Southwell (1993) acknowledged, "there is some evidence to believe that the beliefs that a teacher holds about mathematics affects the way in which mathematics is taught" (p.293). This beliefs to practice notion is further pointed out by Baroody (1987) when he stated:

In brief, whether conscious or not, beliefs about mathematics learning guide decision making and, in the end, influence our effectiveness as mathematics educators (p.5).

The main issue with regard to teacher beliefs, conscious or not, then appears to be the connection of teacher belief to teacher action. However, Kaplan (1991) maintained that beliefs and practice can always be shown to be consistent, regardless of other contributing factors which might weaken the link (Thompson, 1984), when one distinguishes between types of beliefs, such as *deep* versus *surface* beliefs, and corresponding practices, such as *pervasive* versus *superficial* practice.

Van Zoest, Jones and Thornton (1994), categorised teacher beliefs into three types:

- the teacher's view of, or conception of, the nature of mathematics;
- the teacher's model, or view of, the nature of mathematics teaching; and
- the teacher's model, or view of, the process of learning mathematics.

This categorisation arises from a significant work in the area of teacher beliefs by Thompson (1984, 1992) with her analysis of research. In order to outline the general beliefs held by teachers, the discussion will use the categories that have been developed by Thompson and also used by Van Zoest et al. (1994) and Raymond (1995, 1997). This is similar to the categorisation adopted by Ernest (1989) who proposed a model of four elements to describe what constituted teacher beliefs:

- the teacher's conception of the nature of mathematics;
- the teacher's model for teaching mathematics;
- the teacher's model for learning mathematics; and
- the teacher's general principles of education.

Thompson's (1992) synthesis was related to the beliefs of teachers, in general, though one might assume that there were, among her accumulated data and reports some comment from beginning teachers. Much of the reported research is with either pre-service teachers or practising teachers and findings for each group related to beliefs are often very similar and again one might assume from this that beginning teachers would exhibit similar beliefs. However, it is not clear from the available research as to the actual beliefs of beginning teachers. Apart from very recently published work (Raymond, 1997), little work is available to add to the emerging picture of beginning teachers' belief systems. It may even be reasonable to assume that if there are different stages of practice then there may be different associated attitudes and beliefs. Research Questions One and Two address this issue.

## Beliefs about mathematics

Mathematics educators have begun to explore the possibility of categorising teachers' views and beliefs related to mathematics itself. While it may be argued that the categories are interrelated and interwoven in complex ways, this report will comment on them separately for convenience and clarity.

Lerman (1983; 1990) offered two categories of teachers: the *Absolutist* which saw mathematics as a fixed body of knowledge, and the *Fallibilist* which corresponds to mathematics as a problem-solving subject. Ernest (1989) noted three, not dissimilar, categories of belief about mathematics offered by teachers. Mathematics as:

- a dynamic, problem-driven category involving creation and invention—a problem solving view,
- a static, unified body of knowledge; something that is discovered not created—a Platonist view, and
- an accumulation of facts, rules and skills to be used at a later time for a purpose—an instrumentalist view.

These are general categories upon which to base an analysis of research findings into teacher beliefs about mathematics. In fact Raymond (1997) took these categories and used them to produce descriptions for a continuum from traditional (mathematics as a fixed collection of unrelated facts, rules and skills) to non-traditional (mathematics as aesthetic, dynamic, problem driven and expanding). The view of mathematics expoused by recent curriculum documents, as noted in Chapter One, falls more into the Fallibilist/problem solving categories.

The strong message coming from research findings is that very many teachers see mathematics in a traditional way. Way (1996) summarised teachers' notions by writing that:

Maths is something that is learned and used in school mathematics lessons rather than a way of thinking or a set of processes that can be applied across subject areas and in real-life situations (p.177).

This produces an image of mathematics as a set of facts and procedures with a focus on number with one right answer and method (Southwell & Khamis, 1991). It is associated with certainty (Lampert, 1990) and consists of formulas, theorems and results (Raymond, 1997). Perry et. al. (1996) found a belief held by many students of mathematics to be computation and a sequential subject. There are also a number of mathematics myths held by teachers, for example, you either know it or you don't; there is one right way; one has to get the right answer quickly (Frank, 1995; Lampert, 1990).



Many teacher education students give a similar image of mathematics. They have a negative attitude to it, largely dislike it, have little aptitude for it and see no value in learning it (Ball, 1988a; Sullivan, 1989a). Hill (1997) noted students seeing mathematics as a set of rules that must be memorised. Ball (1992) predicted that new university teacher education students entering her mathematics education class might believe the following about mathematics and found it to be true for most of the students:

- Mathematics does not have much relationship to the real world;
- Mathematics primarily involves manipulating symbols;
- Knowing mathematics means knowing ‘how to do it’; and
- I just don’t have a mathematical mind. (p. 20)

The image of mathematics given by the majority of teachers and students is one of hatred, negative feelings and beliefs related to facts, procedures and correctness. Jones (1990) discussed the idea of derivative beliefs; that one belief gives rise to another, which is believed, usually, without supporting evidence. For example, if one believes mathematics is about rules, then the derivative belief becomes that learning mathematics is about learning rules.

## Beliefs about teaching mathematics

A traditional view of mathematics, one of facts and skills to be learned, is the major one emerging from research either for practising teachers or pre-service students (Southwell & Khamis, 1991; Thompson, 1992). This would fall into Lerman's *instrumentalist* category. This traditional view can lead to a teaching model which favours traditional teaching with transmission of facts and skills characterised by exposition, practice and memorisation (Southwell & Khamis, 1991). Learning for children resulting from such a teaching model was described by Skemp (1976) as *instrumental learning*—knowing what to do but not why it is appropriate or with any deep understanding of the idea.

Constructivist approaches to teaching and learning espoused by many teacher education institutions and by curriculum documents seem, on the surface, to be inconsistent with much of what teachers believe and practice in their classrooms. Here, in the classrooms, there is a view of transmission of facts and skills as teaching and a belief that absorption

of them by children is learning (Lokan, Ford & Greenwood, 1996). Beliefs interact in a complex rather than simplistic way, however, and may produce inconsistencies in classroom practice.

As noted in the section related to teachers’ beliefs about mathematics, not all teachers believe the same thing. The same appears to be true regarding teachers' beliefs about teaching mathematics. Raymond (1997) developed a continuum of teachers’ beliefs about teaching mathematics to accommodate divergences of belief. She again used the terms traditional and non-traditional as poles on the continuum.

**Table 2.2 : Teachers’ beliefs about teaching mathematics Raymond (1997)**

<i>Traditional</i>	<i>Non-traditional</i>
The teacher’s role is to lecture and to dispense mathematical knowledge.	The teacher’s role is to guide learning and pose challenging questions.
The teacher’s role is to assign individual seatwork.	The teacher’s role is to promote knowledge sharing.
The teacher seeks right answers and is not concerned with explanations.	The teacher clearly values process over product.
The teacher approaches mathematical topics individually, a day at a time.	The teacher does not follow the textbook when teaching.
The teacher emphasises mastery and memorisation of facts and skills.	The teacher provides only problem-solving, manipulative-driven activities.
The teacher instructs solely from the textbook.	The teacher does not plan explicit, inflexible lessons.
Lessons are planned and implemented explicitly without deviation.	The teacher has children work in cooperative groups at all times.
The teacher assesses students solely through standard quizzes and exams.	The teacher promotes students’ autonomy.
Lessons and activities follow the same daily pattern.	The teacher helps students to like and value mathematics.

Beliefs about teaching mathematics found from the literature could be summarised by the following statements. Teaching mathematics is about covering the curriculum, finishing the textbook, and mastering basic skills and algorithms (McDiarmid, 1990). Teachers and the textbook are the authorities (Lampert, 1990; Perry, Howard & Conroy, 1996). Teaching mathematics involves telling, showing and explaining procedures (McDiarmid, 1990). Any failure to learn is due to the child not having the right home background or attitude or ability (McDiarmid, 1990). Such evidence would tend to suggest that many teachers could be found with beliefs about mathematics teaching that would place them toward the traditional end of Raymond's continuum.

Ball (1992) added aspects of teaching mathematics to her list of beliefs held by student teachers in the following way:

- Teaching mathematics involves telling or showing students how to do different kinds of problems.
- Teachers ask questions to elicit correct answers. If a teacher questions your answer, it means you have done something wrong.
- Good teachers try to make mathematics fun for students.
- Elementary school teaching does not require much knowledge of math—anyone who can add, subtract, multiply and divide knows enough mathematics to teach little kids. Learning to teach, therefore, is a matter of acquiring techniques.
- Love of children, not knowledge of subject matter, is the basis of elementary school teaching.

From this list and the earlier comments related to the thoughts of teachers it can be seen that there is a strong carry through and a consistency of beliefs from student teacher to serving teacher. There is a cyclic approach here whereby, what Buchmann (1987) has called 'folk ways of teaching'—ready-made recipes for action—are reinforced. Such ways are learned by observation as a child in school, later they are reinforced by imitation on teaching practice by teacher education students and then authorised by custom and habit in the schools for new teachers. The same carry through can be seen for beliefs about mathematics as discussed earlier in this section.

Pre-service teachers' beliefs tend to be formed during their own school years (Ball, 1988c) and are usually based on personal experience. They have had direct, almost daily experience of how teachers teach mathematics over the extended period of time of their primary and secondary education. Ryan (1986) also noted that beginning teachers focus on behaviours of teaching that are obvious and well known to them but are largely unaware of the complexities of teaching that are hidden from view. Thus, they begin their teaching career operating on the basis of a very simplified conception of teaching (Rust, 1994).

Thompson (1992) noted that there is support in the literature for the claim that beliefs about instructional practice actually influence classroom practice. Teachers' beliefs, she suggested, appear to act as filters through which teachers interpret and give meaning to their experiences of working with children and subject matter. In her earlier work, Thompson (1984) observed that teachers' reflections played a vital part in making their views of learning consistent with their teaching in the classroom. However, McDiarmid (1990) found that beginning teachers' beliefs about teaching and learning are rarely tested in their teacher education programmes and that when students "appear to reconsider their beliefs, such changes may be superficial and short-lived" (p.12).

There are varying degrees of consistency between teachers' professed beliefs about mathematics and their practice. Thompson (1984) showed a high degree of consistency. She observed that those teachers with an *Instrumentalist* view of mathematics emphasised, in their practice, teacher demonstration of rules and procedures. While, on the other hand, those with a problem-solving view tended to engage children in the process of mathematics. It needs to be recognised, however, that there is an inherent problem with the straightforward cause and effect assumption that classroom practice is purely a result of a teacher's belief about mathematics. Although this is certainly a factor, one should also consider the constraints and influences of the social context of the school in its widest sense. This aspect, the culture of the school, will be discussed later. Thompson (1992) also noted that there is often a discrepancy between the professed beliefs of teachers and what is actually observed in their classroom, and the fact that the teachers are often unaware of these differences. The research considered so far suggests

that belief systems often influence classroom practice; that belief systems are resistant to change and that context acts on beliefs of beginning teachers of mathematics in the primary school.

As a result of an extensive review of the literature Kuhs and Ball (1986) identified the following four distinctive ways in which mathematics is taught:

- Learner-focused—the learner constructs mathematical knowledge;
- Content-focused with conceptual understanding—content-driven but with an emphasis on understanding;
- Content-focused with performance—based on mastery of rules and procedures;
- Classroom-focused—based on effective classrooms.

The learner-focused view of teaching has many common features with constructivist models of learning. Constructivist approaches are emphasised in most pre-service mathematics education courses and are propounded in recent curriculum documents. Anecdotal evidence and the work of Stodolsky (1988) suggests that what tends to be happening in many schools and classrooms is much more inclined to the third category—content-focused with performance (Reynolds, 1992). This suggests that classroom practice is linked to belief systems about teaching. Many teachers, as noted earlier, incline to traditional views of mathematics, which, in turn, leads to a focus in the classroom on content and performance of procedures.

The next section discusses the third aspect of teachers' beliefs, that of their beliefs about the learning of mathematics. As will be seen, all three aspects of beliefs are interrelated to give a complex rather than simplistic picture of the relationship of beliefs to pedagogical practice in mathematics.

## Beliefs about mathematics learning

Raymond's (1997) categorisation of teachers' beliefs about learning mathematics offered a useful compilation of research findings. She established a set of criteria for the traditional end of her continuum, based on the notion that mathematics is learned by transmitting knowledge to students. At the other end of her continuum is the idea that

learners construct mathematics (Underhill, 1988, 1991; Von Glasersfeld, 1988, 1995). At the traditional end of the continuum, the criteria are very similar to the beliefs of student teachers noted by McDiarmid (1990). At the other end, the non-traditional criteria belong more to a constructivist philosophy of learning.

**Table 2.3: Teachers' beliefs about mathematics learning (Raymond (1997)**

<i>Traditional</i>	<i>Non-traditional</i>
Students passively receive knowledge from the teacher.	The students' role is that of an autonomous explorer.
Students learn mathematics by working individually.	Students learn mathematics only through problem-solving activities.
Students engage in repeated practice for mastery of skills.	Students learn mathematics without textbook or pencil and paper activities.
There is only one way to learn mathematics.	Students learn mathematics through cooperative group interactions.
Memory and mastery of algorithms signify learning.	Students are active mathematics learners.
Students learn mathematics solely from the textbook and worksheets.	All students can learn mathematics.
Many students are just not able to learn mathematics.	Each student learns mathematics in his or her own way.
Students' learning of mathematics depends solely on the teacher.	

An association between teachers' theory of learning and their idea of teaching, that is, what the teacher believes about learning mathematics is reflected in the way it is taught in the teacher's classroom appears to be a straightforward relationship. Clarke (1996) and Thompson (1992) questioned this simple cause and effect notion. She had earlier (Thompson, 1984) suggested that such a direct, simple relationship between the two is unlikely, as is also the idea that the two have been articulated into a coherent theory of instruction by the teacher. Thompson suggested that teachers' implicit theories tend to be:

eclectic aggregations of cause-effect propositions from many sources, rules of thumb, generalisations drawn from personal experience, beliefs, values, biases and prejudices (p. 135).

Jones (1990) outlined the idea of derivative beliefs, as discussed earlier, whereby a belief in one area leads easily to an associated belief in another area, thus, for example, if teaching is about telling and showing, then learning is about remembering what has been told or shown. McDiarmid's (1990) work with student teachers found that generally they believed that learning means remembering (the correct procedure or algorithm) and that learning comes primarily from practice. The final section on Ball's (1992) list of student teacher beliefs is related to learning and offered a view of the learner:

Young children are trusting and eager to learn but are not yet capable of thinking about complicated mathematical ideas or solving real problems (p. 19).

In summary there appears to be a strong emphasis among student teachers and experienced teachers that learning mathematics is concerned with the child remembering facts, procedures and skills. These, they believe are learned through individual practice. Traditional beliefs about the content of mathematics, its teaching and learning are apparent from research reports in the literature. While there is evidence of these traditional beliefs being held by student teachers and experienced teachers, the picture for beginning teachers is less clear, as is the notion of changing beliefs over a period of time. The next section will consider other factors that may impinge on teachers' beliefs about mathematics, mathematics teaching and mathematics learning.

## **Context of school, society, and children**

Although it can be shown, (Sullivan, 1989a; Thompson, 1992) that personal beliefs held by teachers are a factor in influencing what happens in the classroom, it cannot be assumed that this is the only factor. Nolder (1990) observed:

It is generally acknowledged that the social context within which teachers work imposes limitations upon what is possible both in terms of classroom practice and curriculum innovation (p.167).

Furthermore, Feiman-Nemser (1983) commented:

Whatever beginning teachers bring to their first teaching situation, that situation will have a powerful effect on them, shaping them to fit the requirements of the role and the place (p.150).

The actual context, the ‘cultural milieu’ (Taylor, 1996), therefore, within which the act of teaching takes place also exerts considerable influence on day-to-day happenings, interactions and teaching style. This ‘teacher socialisation’ (Zeichner, 1983), the constant interplay of individual choice and situational constraint, must be acknowledged as a further factor in any study of teacher beliefs and actions. In this section the influence on the teacher, and especially the beginning teacher, of the school (the context in which the teaching takes place), society, the community and the children in the classroom of the beginning teacher, among other things, will be discussed.

### Context—the school

Mousley and Clements (1990) considered the reality of the school and the classroom—the context for the beginning teacher. They found that one of the major factors preventing the rapid institutionalisation of innovation in teaching was the culture of the school. Institutional tradition is, they noted, a powerful inhibitor of change and a factor in reconfirming people in that tradition.

This social heritage drives and limits much of what happens in school and for many teachers it is hard to develop, or even imagine, a system of classroom interaction that is slightly different from the normality of the school. Mousley and Clements (1990) also pointed out that the social heritage of a school is transmitted from one generation to the next, from the established staff to the new teacher. The idea of social heritage embodies:

- distinctive forms of discourse,
- behavioural norms, and
- common patterns of organisation and ritual.

Mathematics teaching has well entrenched norms (traditional methods) within these fields. It, therefore, presents a very strong resistance to change and in particular to change coming from outside the institution, including change introduced by a neophyte. Inertial forces maintain the status quo and quickly engulf and overwhelm the new arrival. Residual ideologies become a factor, established teaching behaviours remain largely unquestioned, and the ramifications of these ideologies and behaviours are not considered. Classroom harmony becomes more important than the realisation that



inappropriate or inadequate teaching and learning styles have been adopted. It becomes an easier task to keep within this comfort zone, rather than face the possibility of being considered as professionally incompetent. Covering the syllabus takes precedence over learning; completion of material rather than comprehension is emphasised (Desforges & Cockburn, 1987; Romberg & Carpenter, 1986). Thus, many beginning teachers have to struggle to reconcile conflicting conceptions between what is desirable and what is possible within the workplace (Cooney, 1985; Lin, 1996; Rust, 1994).

Sullivan (1989a) illustrated teachers' preoccupation with the need to maintain control. Thus, routines become reified, and transmission models with skill and procedure teaching and testing become the norm, as these can be used more easily to control the children. Open-ended work with investigating, discussing and use of materials tends to be noisier. It produces a variety of end points, and involves movement by the children, all of which are equated as evidence of poor teaching by those, whose experience is limited to that of a traditional classroom of silence and individual learning procedures.

For many beginning teachers there is the 'reality shock' (Weinstein, 1988) of having a class to oneself, with no supervising teacher to take responsibility for the everyday happenings of school life. Even though beginning teachers have worked in classrooms with children before, many still have unrealistic, often idealistic, expectations of classrooms and teaching, all of which contributes to this shock (Raymond, 1997; Rust, 1994; Weinstein, 1988). They face the collapse of missionary ideals formed in teacher training, brought on by the harsh and rude reality of everyday classroom life (Veenman, 1984). They are largely unaware of the organisational, administrative and interpersonal forces that are likely to influence their school lives. They may have to use specific textbooks, prepare for special tests or have limited materials and resources (Jones, 1990). Often they are placed in situations no different from their experienced colleagues or they are presented with the most difficult tasks and least desirable classes (Weinstein, 1988). They suddenly have to cope with a multitude of things peripheral to their main task of teaching (Bullough, 1989; Kagan, 1992). Thus, the actual constraints of the school tend to push the beginning teacher to implement more traditional practices with seemingly certain, quick and productive returns, and so reduce the risk of failure (Brown & Borko,

1992; Kennedy, 1997; Raymond, 1997). Initial student-centred teaching behaviours change into more authoritarian ways. For many the 'liberal' attitudes formed during teacher training return to a more 'conservative' view (Veenman, 1984). The beginning teacher has to reconcile, in many instances, conflicting conceptions between what is desirable, and what is possible, within the constraints of preparation time and the work situation. Beginning teachers are ill-prepared to develop their own teaching style under these pressures or to deal with the negotiations that are necessary to develop one's confidence and status in an institutional setting (Rust, 1994). New teachers are strongly affected by the conditions of the workplace and most particularly the 'climate of acceptance' established by the Principal (Rust, 1994). Here is the 'wash-out effect' of pre-service education noted earlier. Thus, learning to teach, for many, is viewed largely in terms of induction into institutional values and practices—the ways of thinking and acting which predominate within the school (Calderhead & Shorrock, 1997).

## Community influences

Expectations, both real and perceived, play an important role in shaping teacher development in general, and beginning teacher development in particular (Sparrow & McIntosh, 1998). The expectations are seen to emanate not only from the school, but also from the wider perspective of the parents; the community; and the pupils themselves. All of these people believe they know, from their experience of being a pupil in school, what it is to be a teacher, how teachers should behave and what they should do. For the most part this is a traditional view of the teacher as the transmitter of knowledge, skills and procedures.

Nolder's (1990) work identified the main constraints to change identified by teachers as time, parental expectations and public examinations. Pupils of primary teachers in Western Australia are not subject to public examinations, in any direct sense, as there is no statewide testing. Some pupils are, however, monitored by sample State testing and compared with children of a similar age. Schools often use these tests to check how their students are doing, so the pressure is still real for many teachers. Selected monitoring is not the case, however, in the rest of Australia, and in the world in general, where

independent testing is used. Teachers are aware of accountability, of being seen to do 'the right thing' by the parents, community and their colleagues. In most situations 'the right thing' means traditionally taught mathematics (Sparrow & McIntosh, 1998).

## Children in the classroom

Nickson (1992) considered the shared meanings which teachers and children bring to the classroom and how these meanings govern the interactions within it.

What has emerged in this study is that the culture of the mathematics classroom will vary according to the actors within it. The unique culture of each classroom is the product of what the teacher and pupils bring to it in terms of knowledge, beliefs and values and how these affect the social interactions within that context (p. 111).

Thus, children in the classroom have a most immediate and significant influence and constraint upon teachers and what they do. Cooney (1985) noted that beginning teachers are often equipped with minimal coping skills and conceptions of mathematics and teaching, and face a potential struggle of their beliefs and values with students' expectations about teachers and the curriculum. The temptation to move to routines and traditional ways of teaching is strong, as these routines increase the predicability and decrease the anxiety for both teachers and children (Kennedy, 1997). Raymond (1997) highlighted the case of Joanna, a beginning teacher, who believed that cooperative learning was the best environment for exploration and learning mathematics. She, however, anticipated poor behaviour among her pupils and did not put her belief into practice, instead adopted more traditional pedagogical practices. Thus, teachers' experiences with students may have a more powerful influence on teacher socialisation than interaction with colleagues or supervisors (Rosenberg, Griffin, Kilgore & Carpenter, 1997; Zeichner & Gore, 1990). However, Kagan (1992) has argued that the most significant influence in the professional development of beginning teachers is their increasing knowledge and understanding of their pupils. From this, they are able to engage in reconstructing their idealised and often inaccurate images of students, and, as a result, modify and adapt their entering views of teaching.

## Experience

Investigations of student teacher perceptions of teaching have suggested that they begin their teacher education programmes at university with well-established notions of what teachers do and what teaching is like. These perceptions are based on their previous experiences and interactions with teachers (Weinstein, 1988). Lortie (1975), in his classic work, described this phenomenon as the ‘apprenticeship of observation’; the sixteen years of sitting in classrooms watching and experiencing a mathematics teacher at work. This ‘cumulative experience of school lives’ contributes to well-worn and common sense images of teachers’ work (Wideen, Mayer-Smith & Moon, 1998). Teaching is seen as a simplistic, mechanical transfer of knowledge and information (Weinstein, 1990). Beginning teachers take these perceptions into their first year of teaching. Other students have a similar image of teaching developed from their experiences of working in child-care or as baby-sitters (Reynolds, 1992). Research on teachers and beginning teachers, in particular, has suggested that their teaching relies heavily on images of practice that are acquired from past and current experiences in school. Often these are taken-for-granted and adopted uncritically (Calderhead, 1988). Without any analytical insight, teaching may quickly reach “a plateau where it has become routine, conservative and unproblematic” (Calderhead, 1988, p.62).

## Teacher education course

It was noted earlier that many beginning teachers enter their pre-service training course with a perception that they already know how to teach mathematics from their time as pupils in classrooms. Such beliefs often discourage these prospective teachers from giving serious attention to pedagogies that rest on different views of teaching and learning (Feiman-Nemser & Featherstone, 1992). Thus, many teachers leave their pre-service courses with their initial views intact (Lacey, 1977; Raymond, 1997; Tabachnick & Zeichner, 1984) having had “the experience but missed the meaning” (Wilson, 1992, p.144). They may, in some cases, reconsider their views but generally any changes in beliefs are superficial and short-lived (McDiarmid, 1990). McDiarmid further suggested that many prospective teachers complete their teacher education course without having examined their fundamental beliefs about mathematics, teaching and learning. They are

rarely aware of the assumptions upon which they base their teaching ideas, beliefs and practices. Information from the university teacher education course is often reconfigured to fit their initial ideas; any that do not fit easily are rejected or ignored (p.13). Thus, the influence of teacher education programmes, as with any education programme, can be quite individualistic. Given the same experience and course work, individual teachers exit preparation programmes with variations in understanding and ability to implement programme content (Rosenberg, Griffin, Kilgore & Carpenter, 1997).

Research by Sullivan (1989a) found that many students entered their pre-service teacher education course with negative views about mathematics. Nisbet (1991) has shown that although pre-service students may have had negative feelings towards mathematics they did not show the same negativity to the teaching of mathematics. Their teaching, however, tended to be based on a transmission approach, which led to instrumental learning, by their students.

Many students and teachers see the practicum parts of the university teacher education course as being central to learning about teaching (Feiman-Nemser & Buchmann, 1989). Zeichner (1990) emphasised that one should not assume that experience always equates to educative experience and that the suggestion of the more experience, the better the learning, is, in fact, false. Calderhead and Robson (1991) have noted the role of the school as a socialising agent, which 'washes out' the effects of training. For many students the school experience will confirm their held beliefs that teaching is a simple job of imparting knowledge. Without the necessary reflection and thought about the experience, little will be gained and assumptions will remain unquestioned. Ways of working will be taken-for-granted, and assumed to have an underpinning of theory and reason, even where there is none. Learning to teach is often viewed as a process of modelling, of acquiring 'images of action' and, without thinking, the beginning teachers may adopt fairly uncritically the actions of their supervising teachers (Calderhead, 1988). Lacey (1977) provided a summary of the influence of teacher education courses when he noted:

Teacher education provides a stressful but ineffective interlude in the shift from being a moderately successful and generally conformist student, to

being an institutionally compliant and pedagogically conservative teacher (p. 42).

There is some evidence to suggest that many students do not alter pre-training beliefs during their teacher education course and thus teacher education courses have little or no effect on the practice of teachers in their first year. Sullivan (1989a), for example, noted the narrow, instrumental goals and restrictive practices that existed in beginning teachers' mathematics classrooms, many of which were direct contradictions of the stated beliefs of the particular teachers espoused during their teacher education course. He illustrated the point with a case study of Helen, who stated that her teaching in her first year in school was influenced by her own ideas and values and school-based factors. "No aspect of the college-based program was recognised as having an influence" (p.8). Weinstein (1990) cited Knowles and Chavez (1989) who found that in some instances students' initial preconceptions of teaching and learning mathematics were still intact at the end of the teacher-education programme. She also noted that for many pre-service teachers the surface activities of mathematics in the primary school classroom are so familiar that, in fact, they enter the programs believing they already know what teaching is all about. Moreover, beginning teachers tend to enter the field concerned about how to organise instructional environments and how to establish general management routines (Ball & Feiman-Nemser, 1988; Veenman, 1984). With regard to the content of mathematics instruction, McDiarmid (1990) found that beginning teachers tend to think of elementary mathematics as simple and believe that what they do not know, they will learn on the job. The subject matter of mathematics is considered to be trivial. Often those students who are concerned about their lack of knowledge of mathematics opt to teach only younger children as they feel the content of mathematics will be within their grasp.

Thus one of the main factors emerging from the debate regarding the influence of the training institutions on practice is that they have very little effect on the actual teaching that takes place subsequently in the school context.

### **Beginning teachers' content knowledge**

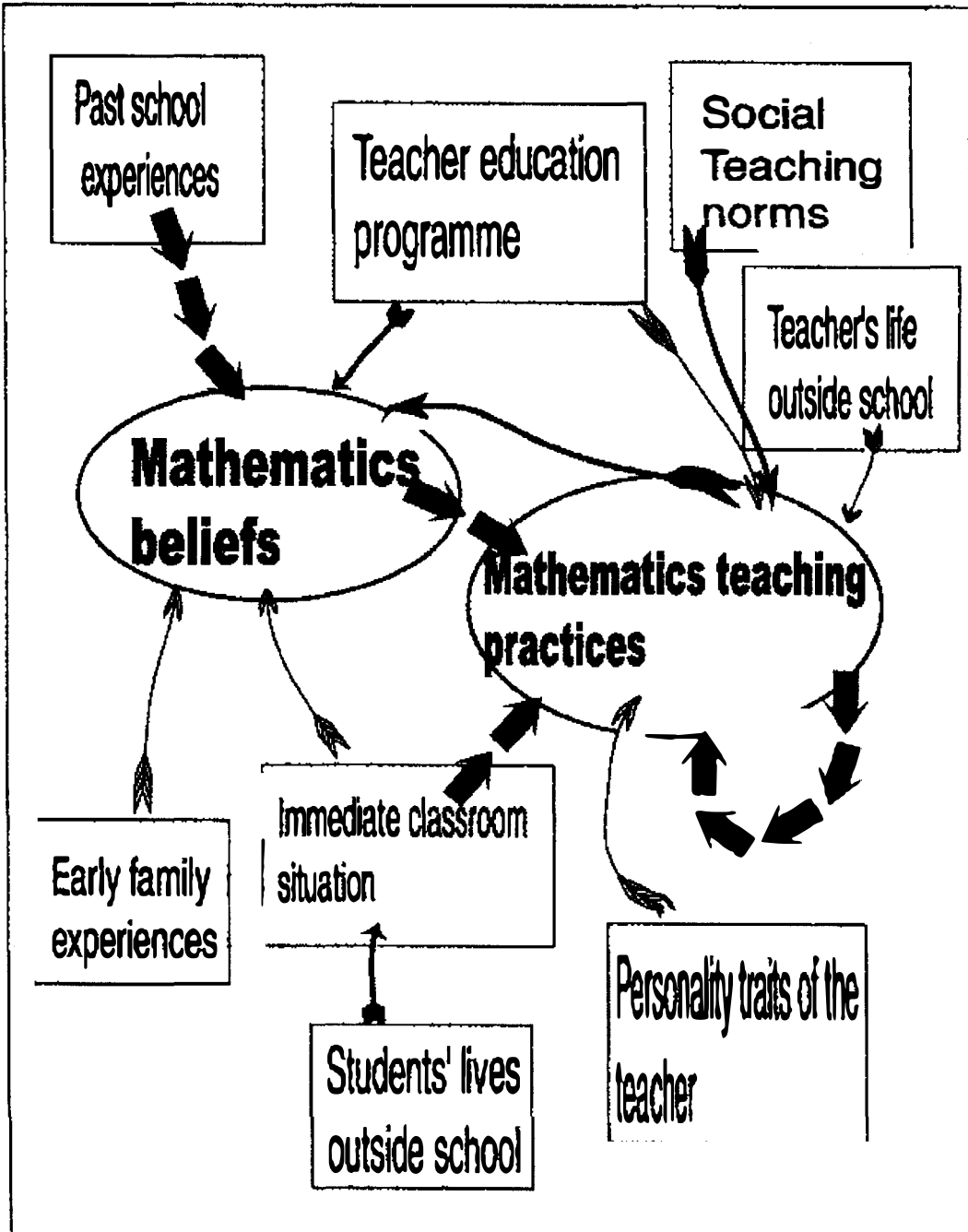
The importance of knowledge related to subject matter, as an essential component of teachers' professional knowledge has been the subject of analysis for a number of years

(Ball & McDiarmid, 1989; Shulman & Grossman, 1988). Two aspects of this knowledge are proposed: subject matter knowledge and pedagogical content knowledge (Ball, 1988a, 1992; Shulman & Grossman, 1988). Borko, Eisenhart, Brown, Underhill, Jones and Agard (1992) found that many beginning teachers and student teachers do not have the necessary conceptual understanding of the mathematical content, to put into action their beliefs about good mathematics teaching. They highlighted the case of Ms. Daniels, who was unable to translate the content from her mathematics course, into her own knowledge or move away from the shallow learning from the textbook into the use of other resources. Observations by Her Majesty's Inspectors of Schools in the United Kingdom (DES, 1987) have suggested that subject knowledge is a factor in beginning teachers' classroom practice. Those beginning teachers, they noted, with poor or insecure subject knowledge tended to adopt a tight adherence to textbooks, narrow, closed questions and an over prescriptive methodology, whereby the beginning teacher remained in a comfort zone of safe routines and procedures. A later section of this report will consider in more detail factors affecting and influencing the pedagogical practice of beginning teachers.

### **Interaction between factors and practice**

More recently Raymond (1997) has proposed a model for the relationships between mathematics beliefs and practice for beginning teachers which incorporated the factors discussed in this section.

Figure 2.1 : A revised model of relationships between mathematics beliefs and practice. (Raymond, 1997)





Her model showed a complex interrelationship between factors that influenced beginning teachers' mathematics beliefs and mathematics teaching practices. The thicker arrows represent the degree of influence of the factor, for example the immediate classroom situation has a major influence, whereas the personality traits of the teacher is only a minor influencing factor on mathematics teaching practices. Previous discussion in this chapter noted the influence of each of Raymond's factors on the pedagogical practice and beliefs of teachers and beginning teachers.

## Summary

In summary, it can be seen from the research literature on factors affecting teachers' and beginning teachers' classroom practice, that the picture is a complex and interrelated one. While beliefs about mathematics, mathematics teaching and mathematics learning held by teachers are an important influence, they should not be seen as the only factor. Context and experience also play an important and significant role in shaping the pedagogical practice of the mathematics classroom as demonstrated by Raymond's model. One aspect of possible influence on teachers' beliefs and pedagogical practice, missing from Raymond's model and from much of the literature, is that of the factor of professional development. There is no research to indicate the influence of professional development on the practice and beliefs of beginning teachers in their first year of teaching. This issue will be addressed by Research Questions 1, 2 and 3.

From the research findings discussed above it seems that teacher and student teacher beliefs are important factors in relation to their classroom practice, and ultimately the quality of learning experienced by their pupils (Kagan, 1992; Kennedy, 1997). It also appears that these beliefs are difficult to change or develop; Feiman-Nemser and Featherstone (1992) noted the "centrality and tenacity of prior beliefs" (p. 6). If teachers' beliefs influence their teaching practices, then a reasonable expectation in professional development might be to influence and change teachers' beliefs and thus their classroom practice in mathematics. How one might influence teachers' beliefs and their pedagogical practice will form the focus of the next chapter.

## Chapter Three

### **Changing practices of beginning teachers of mathematics: A review of the literature**

#### **Introduction**

In this chapter the discussion will consider learning to teach and general models for teacher professional development and draw from these important pointers for the development of beginning teachers. An overview and analysis of three significant models, Transmission, Partnership and Empowerment follow this. The chapter will identify principles for professional development that underpin effective, long lasting teacher development in classrooms. In particular it will highlight the overarching importance of teacher reflection and discuss methods, for example action research and case methods meetings, for achieving empowerment in the classroom. The chapter will then identify the needs of beginning teachers, as noted by research findings. From here there will be a short discussion on strategies for supporting beginning teachers in the classroom. Finally a support and professional development model specifically for beginning teachers of mathematics in the primary school will be proposed. This model formed the basis for supporting beginning mathematics teachers participating in this study.

#### **Learning about teaching**

This study will use the definition of professional development offered by Jaworski (1993). Namely, teacher professional development is:

that natural process of professional growth in which a teacher gradually acquires confidence, gains new perspectives, increases in knowledge, discovers new methods, and takes on new roles (p. 10-11).

The use of the words ‘natural’ and ‘growth’ align the principles of this approach more with a constructivist philosophy (Underhill, 1991; Von Glasersfeld, 1995) and place it in

Calderhead's (1993) *personalistic paradigm*. This paradigm views learning to teach as a process of personal growth from the beginning teacher's beliefs and commitments. Discussion of the idea of personal growth will follow, in more detail later in this chapter, under the heading of empowerment models of development and support for beginning teachers.

Current educational reform efforts (Australian Education Council, 1991; Curriculum Council of Western Australia, 1998; DEET, 1989; EDWA, 1998; NCTM, 1989) are setting ambitious goals for schools, teachers, and students. In this vision, classrooms are to be places where teachers and all students engage in rich discourse about important ideas and explore interesting problems grounded in meaningful contexts. These new visions of classrooms represent a substantial departure from most classrooms today. Moreover, they are based on different assumptions and beliefs about mathematics, its content, its teaching and learning and schools. To move toward these goals will require significant learning on the part of teachers as they impinge dramatically on teachers' knowledge, beliefs and teaching practices. Such progress is unlikely to happen without the support and sensitive guidance of appropriate professional development (Borko & Putnam, 1998).

If one is to help teachers make these changes successfully, then one has to pay attention to how adults learn. The lessons and principles from this analysis have to be incorporated into any professional development package. Knowles (1980) first proposed adult learning theory, known as the science of andragogy. He developed a theory based on the premise that adults are self-directed learners who are unique, due to their personal experiences.

Their need to learn results from their desire to face the challenges they encounter. Knowles' (1984) seven elements of learning include:

- Climate setting;
- Involving learners in mutual planning;
- Involving participants in diagnosing their own needs for learning;
- Involving learners in formulating their learning objectives;
- Involving learners in designing learning plans;
- Helping learners carry out their plans; and
- Involving learners in evaluating their learning.

Self-direction, he suggested, was the keystone of adult learning. The needs and the experiences of the learner should take precedence over the expertise of the instructor. With these principles as parameters, the discussion will now consider three main models for the professional development of adults, in this case, teachers.

### Models of professional development

While acknowledging that the means by which teachers develop their practice is little understood (Edwards, 1996), there are some indicators emerging which offer pointers to a more effective direction to identifying these means. Over the years teachers and teacher educators, among others, have designed and implemented various models for professional development in order to promote, support and change teaching styles and classroom practices. Clarke and Hollingsworth (1994) presented a useful summary and classification of the models of change used. They noted the interrelatedness of the models and outlined the change agent involved. In most cases, this agent was an external one to the person or people expected to change. From the literature on professional development, one can loosely group the models into three categories —Transmission, Partnership and Empowerment. Generally, they vary according to the amount of external expert input they contain. Using this criterion, those approaches that transmit new information to teachers via conferences, workshops and inservice work make a group.

Secondly, those models involving a partnership between teachers and others form a group, and finally, models, which involve empowering teachers to direct their development also, form a collection.

The next section of the discussion will outline each of these models and offer conclusions related to their effectiveness in developing and supporting change in the practice of teachers.

### Transmission models of professional development

Shulman (1998) discussed aspects of the work of Dewey and the education of professionals. Dewey identified two general approaches to preparing professionals: an apprenticeship model, which is aligned with a transmission of facts and skills approach, and a laboratory model, similar to an empowerment model. The apprenticeship model he considered a backward looking model, where the learner learns from demonstration. The final product is that the learner can copy and reproduce existing practice. This approach tends to maintain the status quo, rather than developing and supporting change in practice. In the laboratory model the learner learns from experimentation with new practices and untested proposals. He suggested that:

The concept of apprenticeship rests on modelling after and imitating the wisdom of practice, seeking to consolidate the hard-won gains of past traditions of practice. Apprenticeships are local, particular, situated. Laboratories produce more general knowledge that is portable, cosmopolitan, and broadly transferable (p. 512).

Shulman proposed to break the cycle of tradition. The apprenticeship model would produce classroom managers who would uncritically follow traditional practices, and therefore, continue traditional practices. He wished to produce, through a laboratory model, “reflective professionals disposed to examine their teaching and their students’ learning critically” (p. 515).

Gordon and Tyson (1995), for example, identified a high level of criticism of the transmission approach in recent years. Failure can be attributed to its inability to foster long-term change and to incorporate teacher expertise. The expectation of transmission

models of professional development is that teachers will implement information after only a cursory exposure to it. The professional development agenda is rarely each teacher's agenda, and there is usually minimal or no support for those who attempt implementation of the ideas (Pierce & Hunsaker, 1996). Robinson (1989) noted the phenomenon of "innovation without change", often resulting from this model, where many schools and teachers pretended to innovate and adopt new ideas but, in fact, preserved their previous practices (p. 269). District-level in-service has been criticised as "pedagogically naive ... a demeaning exercise that often leaves its participants more cynical and no more knowledgeable, skilled or committed than before" (Miles, 1995). In fact, many leave courses without the ability to apply new skills or knowledge once back in the work place (Galbo, 1998). In terms of developing long term change in teacher practice, the transmission approach appears to be ineffective in most cases.

### Partnership models of professional development

These approaches involve the teacher and the researcher in various forms of collaboration, usually a partnership and often through an action research model. For example, Ellerton, Clements and Skehan (1989) worked with a school to develop investigative approaches to teaching and learning. The impetus for using this approach came initially from an external source to the school. The project progressed via an action research model, which involved teachers from the school structuring the development and emphasis of the work. The pairing or partnership allowed for the development of programs and reflection on practice. Reports of these projects suggested considerable learning by both partners and some significant change in classroom practice (Cobb, Wood & Yackel 1990; Ellerton, Clements & Skehan 1989).

Gordon and Tyson (1995) commented that usually the important thing missing from both Transmission and Partnership models was an emphasis on the role of teachers as decision makers, and in setting their own agenda. In fact, professional development often holds an assumption that the developing, reforming or empowering is done by someone else—not the teachers themselves. The external agent, rather than the internal participant, makes

the decisions and decides the direction of action, to a greater or lesser extent. Barnett and Tyson (1993a) argued:

At one extreme, programs may actually predicate their goals on the assumption that teachers are resistant to change and must be prompted by accountability or top-down expectations (p. 2).

Richardson (1990) also noted that the literature on teacher change, whether research-based or otherwise, emphasised teachers doing something suggested by others. Thus, teachers are disempowered because change is externally legitimised. The notion of an external agent setting the change agenda has limitations for many situations and teachers. If the agent of change is to be long lasting and effective, then it appears that it has not to be external to the teacher, but internal, and in the domain of the teacher. The next section will consider models for professional development which utilise teachers as directors of change.

### Empowerment models of professional development

It appears to follow that, if one is to use the natural processes of professional growth, then the learner should have a leading role. According to Cooney (1996), teachers are learners, therefore teachers should have ownership of their development. Cooney (1996) argued for an individual, be it an experienced or beginning teacher, ‘coming to know’ based on their own reasoning processes, rather than relying on external sources for that knowledge. In this way, the teacher is helped to value his or her voice as well as integrating the voices of others, to use Belenky, Clinchy, Goldberger and Tarule’s (1986) terms. Richardson (1994) also saw the teacher as the one who mediates ideas, constructs meanings and knowledge and acts on them. The ideas, however, may come from many different sources. New understandings develop from these ideas as they interact with existing understandings. From this approach should emerge a teacher’s ability to be analytical, attentive to context and having developed a professional self-concept (Calderhead & Shorrock, 1997).

Research by Herrington, Sparrow and Swan (1995) used an action research model of professional development that considered an emphasis of teachers setting their own

agenda. The case methods model (Barnett, 1992; Barnett & Friedman 1997; Barnett & Tyson 1993b; Gordon & Tyson, 1995) also recognised that the teacher must have a central role. In fact, one of the primary goals of the model has an expectation of teachers recognising themselves as their own change agents. A fuller discussion of action research and case methods will follow later in this chapter. These projects provide examples of a third category of professional development, namely an Empowerment model. Essentially, in this category, teachers' concerns, interests and the realities of their classroom drive the programme. In this sense, it is a model of teacher empowerment, in which teachers identify and meet their own needs for professional development. Robinson (1989) discussed the empowerment paradigm and noted the shift from the manipulation of teachers by others, to one of personal control of professional development. This represents a move from an instrumental view of teachers, as passive recipients of knowledge, to one of teachers as responsible professionals, constructing viable meanings within a context.

Robinson argued change and professional development should be an educative process with no universally correct and acceptable end-point. Information about the range of choices available is given to teachers so that they can make meaningful choices for their classroom. The focus of the management paradigm—the external force—is for change, while that of the empowerment paradigm is choice (Ellerton, 1996).

Johnson and Owen's (1986) model of teacher improvement provided a useful illustration of the empowerment paradigm and has much in common with Knowles (1984) elements of adult learning. According to Johnson and Owen, there are five stages of development:

- Recognition: Teachers become aware of their current practice and teaching-learning methods;
- Refinement: Teachers vary their teaching-learning strategies to explore whether changes help student learning;
- Re-examination: Teachers examine elements of their classroom teaching and compare them to other possible approaches;
- Renovation: Teachers adopt new teaching-learning repertoires; and



- **Renewal:** Teachers re-evaluate the use of their methods for teaching and learning and plan any necessary additions.

Begg (1996) noted that:

the mathematics departments making the most successful changes seemed to be the ones where the teachers were empowered and were in control of their own development (p.14).

As with Robinson, he offered a warning to researchers and professional development facilitators to beware of pushing for change rather than empowering teachers. He suggested to keep in mind the question—Are you trying to change others or are you empowering them to change themselves? Robinson (1989), in a similar way, pointed out the danger of the external person who moved from facilitator to ‘evangelist’ and caused the teachers to change into the self-image of the facilitator, irrespective of the teachers’ wishes and needs. Grundy (1996) discussed an interesting development of the debate about researching in schools, which fits comfortably with the empowerment model and possibly avoids some of the pitfalls noted earlier. She talked of building professional research partnerships with teachers and schools. In this relationship the teacher and the researcher worked collaboratively and negotiated with each other to advance their respective interests within the complex context. She termed this “researching with the profession” (p. 3), and contrasted it to “researching in the profession” (p. 3), where members of the profession become the subject of and provide sites for educational research. The latter form would fall into the second category of professional development, a partnership model, as discussed earlier. The notion of “researching with the profession” leaves teachers with the responsibility to direct and develop the project as they wish.

An empowerment model emphasises supporting teachers in developing their classroom practice or in changing an aspect of it in a desired way. The model may have been used with beginning teachers, in the sense that beginning teachers may have been involved in the projects. Nothing, however, is reported in the research literature about the impact of this model on classroom practice of the beginning teacher. The empowerment paradigm stresses, firstly, a change in the nature of thinking that teachers have with their setting. Secondly, to have teachers consider the possibilities inherent in the situation they inhabit.

Finally, to summon alternative realities (Prawat, 1991). At the same time, the control of the situation remains with the teacher. For these reasons, the empowerment paradigm would seem well suited to working with beginning teachers.

## **Principles for effective professional development of teachers**

From the earlier discussion on factors influencing teachers' practices and models for professional development, a number of points and recommendations arise. This section will identify and discuss those points and then provide a synthesis of them. This synthesis will later form a professional development model to support beginning teachers in their teaching of mathematics in the primary school.

Clarke and Peter (1993) have noted that the processes of change in teachers' practices, knowledge and beliefs are intertwined and form part of a learning process.

They suggested two central components of professional growth:

- teacher experimentation, and
- teacher reflection.

Bearing this in mind, and the earlier comments on the inadequacy of the transmission models of professional development in establishing long-term change, it would seem more appropriate to consider models that involve the teacher directly and overtly in this process, namely, the empowerment paradigm, as described earlier. One will need to create situations where beginning teachers face and consider their beliefs, in order to help the change process. This demands powerful interventions, which gently challenge, and yet are safe situations, in which beginning teachers can begin to take mathematical, emotional and intellectual risks (Wilcox, Schram, Lappan & Lanier 1991). The model for developing beliefs as outlined by Ellerton and Clements (1994), and described at the end of this Chapter, is an example of a way that allows emotions and attitudes to be exposed.

Useful summaries of key principles for professional development of teachers are provided by Clarke (1994), Louden (1994) and Speck (1996). These principles appear below with a final summary of their main similarities. This summary informs the

construction of a new professional development and support model for working with beginning teachers. No such model, related directly to the needs and context of the beginning primary mathematics teacher exists in the literature.

Clarke (1994) identified ten key principles from research for the professional development of mathematics teachers (Table 3.1).

**Table 3.1 : Ten key principles for the professional development of teachers. (Taken from Clarke, 1994).**

- Address issues of concern and interest, largely (but not exclusively) identified by the teachers themselves, and involve a degree of choice for participants.
- Involve groups of teachers rather than individuals from a number of schools, and enlist the support of the school and district administration, students, parents and the broader school community.
- Recognise and address the many impediments to teachers' growth at the individual, school and district level.
- Using teachers as participants in classroom activities or students in real situations, model desired classroom approaches during in-service sessions to project a clearer vision of the proposed changes.
- Solicit teachers' conscious commitment to participate actively in the professional development sessions and to undertake required readings and classroom tasks, appropriately adapted to their classroom.
- Recognise that changes in teachers' beliefs about teaching and learning are derived largely from classroom practice; as a result, such changes will follow the opportunity to validate, through observing positive student learning, information supplied by professional development programmes.
- Allow time and opportunities for planning, reflection and feedback in order to report successes and failures to the group, to share "the wisdom of practice", and to discuss problems and solutions regarding individual students and new teaching approaches.
- Enable participating teachers to gain a substantial degree of ownership by their involvement in decision making and by being regarded as true partners in the change process.
- Recognise that change is a gradual, difficult and often painful process, and afford opportunities for ongoing support from peers and critical friends.
- Encourage participants to set further goals for their professional growth.

A similar list for best practice in the professional development of teachers (see Table 3.2), which addressed general criteria was constructed by Loudén (1994).

**Table 3.2 :Best practice in professional development (Louden, 1994)**

Planning	1	Is relevant to teachers' interests and experience
	2	Is founded on teacher and staff needs
	3	Clearly defines goals, processes and outcomes
	4	Provides enough flexibility to accommodate the needs of individual teachers
	5	Involves committed participants
	6	Offers equal access to all teachers regardless of their geographical location or type of school
	7	Brings together teams of classroom teachers
	8	Requires preparation by participants
	9	Addresses various levels of need (eg. teacher, school, system)
Facilitation	1	Involves leaders with expert knowledge and practical know-how
	2	Provides high quality materials and resources
	3	Locates activities in pleasant and comfortable surroundings
	4	Involves teachers drawn from both similar and diverse professional settings
Implementation	1	Demonstrates a clear relationship between theory, research and practice
	2	Provides opportunities for active engagement
	3	Takes account of how adults learn
	4	Builds knowledge and ownership through action research
	5	Balances curriculum and pedagogical issues
	6	Uses a variety of presentation styles
	7	Involves modelling of exemplary practice
	8	Sequences and spaces activities over time
	9	Contains both structured and unstructured time, with participants able to reflect upon implications for their professional practice
	10	Makes optimal use of time available
Application	1	Involves planned follow-up
	2	Develops teamwork and mutual respect
	3	Creates a feeling of excitement, empowerment and ownership
	4	Translates into practical knowledge and skills gained in professional development
	5	Supports teachers' accountability for student outcomes
	6	Rewards participation and achievements through academic credit, employer recognition, career advancement opportunities, or remuneration for time spent
	7	Encourages transferability of learning across school sectors and subjects

A third list of elements (Table 3.3) provided by Speck (1996) is based on the growing body of research in professional development, adult learning theory, shared leadership, effective schools and the change process.

**Table 3.3 : Twenty key elements of effective professional development (Speck, 1996)**

- |    |  |
|----|--|
| 1  | Increasing student learning is the overarching goal of all training  |
| 2  | The school is the unit of change   |
| 3  | Professional development is an ongoing process, not a “one-shot approach”  |
| 4  | All educators should be life-long learners   |
| 5  | The involvement and support of the principal is a key factor   |
| 6  | Setting and working toward improvement goals should involve stakeholders in the school   |
| 7  | Improvement efforts must recognise the values, norms and beliefs that shape school practice and culture  |
| 8  | Policies and practices must be connected to the change process   |
| 9  | Ownership and commitment is gained through input   |
| 10 | The primary goal of professional development is school improvement, but both school and individual growth must be addressed in the effort                              |
| 11 | School districts must provide resources to schools for this purpose  |
| 12 | Planning and implementation should use adult learning theory   |
| 13 | Coaching and ongoing systematic support are required for the transfer of learning from training into applied, daily practice   |
| 14 | Schools should provide recognition and rewards for those involved in efforts to grow professionally  |
| 15 | Stakeholders must share decisions about time schedules, curriculum, personnel, space and materials   |
| 16 | Professional development should support instructional and program improvement  |
| 17 | Educators must have opportunities to learn for themselves  |
| 18 | Opportunities should be provided inside schools to discuss, practice and reflect on new skills   |
| 19 | Participation across job function/role increases shared understandings and stimulates the use of new approaches  |
| 20 | Broader support mechanisms outside the school are needed, such as networks, collaboratives, coalitions and partnerships with individuals and groups outside the school |

A comparison of similarities between each list offers the following pointers for designing a support model for beginning teachers. Note, however, that the three lists, given above, relate to teachers in general and not to beginning teachers specifically.

**Table 3.4 : Similarities of essential elements of professional development between Clarke, Louden and Speck.**

Clarke	Louden	Speck
Issues identified largely by teachers	Founded on teacher and staff needs	
Degree of choice by participant	Flexible enough to accommodate individual needs of participants	Stakeholders share decision making
Involve groups of teachers	Brings together groups of teachers	
Support of broader school and community		Involvement of Principal is crucial
Uses students in real situations to model desired approaches	Involves modelling exemplary practice	
Teachers undertake classroom tasks	Requires preparation by participants. Provides opportunities for active engagement	
Changes in beliefs about teaching and learning derived largely from classroom practice	Builds knowledge and ownership through action research	
Time for reflection	Reflect upon implications for professional practice	Opportunities provided for discussion and reflection
Enable ownership in decision making	Develop empowerment and ownership	Ownership and commitment gained through input
Recognise it as a gradual process and provide ongoing support		Professional development is an ongoing process. Coaching and systematic support are necessary
Encourage setting further goals	Involves planned follow-up	

From the comparison shown above certain similarities may be noted. These similarities can form part of the structure for a professional development and support model for beginning teachers. Similarities between the lists are:

- Professional development is a gradual and ongoing process;
- Ownership by the teacher is important;
- Teacher reflection is needed;
- Teachers need to take an active part and ground new ideas in the classroom for change to take place;
- The input of other teachers is needed to offer a wider perspective; and
- Teacher needs should form the basis of the development.

The support model incorporates these aspects because they also match other principles seen as necessary for adult learning, for example, constructivist ideas as noted earlier and discussed in more detail later in this chapter.

## **Working with teachers and empowerment models**

The next section will consider the principles underpinning suitable models of working with teachers to meet the demands of the Empowerment model, findings from the research literature on professional development and their appropriateness to beginning teacher development. Moreover, if one is employing principles of teacher empowerment, then the role of the researcher or the non-teacher becomes important. A discussion of appropriate human roles will form a second part of the next section.

### **Teacher reflection**

The notion of the reflective teacher, one who reflects in and on their practice, has been advocated for a number of years, particularly in the work of Pollard and Tann (1987) and Schon (1983). Studies by Bobis and Cusworth (1995), Calderhead (1989), Prawat (1992b), Raymond and Santos (1995), Smyth (1989b) have also used this aspect as part of their studies with teachers.

Teacher reflection is an important characteristic of all empowerment models. It is discussed here as a separate issue but should be seen as an integral and vital part of specific models for working with teachers, for example action research and case methods meetings.

Teacher reflectivity enhances the skills necessary for teaching to occur effectively (Pultorak, 1996), by emphasising the critical examination of teaching and the persistent exercise of judgement about curricular and instructional issues. Teaching is often seen as consisting of practical problems, requiring deliberation and action for their solution. This action should be, however, intelligent action, in which justifications and consequences are considered; rather than blind, impulsive reaction. Reflection is viewed as a process of becoming aware of one's context, of the constraints imposed by society and of the

influence of ideology on previously taken-for-granted practices. It is through reflection that teachers can regain control of situations or comprehend them in better ways (LaBoskey, 1993). Reflection is a way to gain control and direction over these influences. Teachers develop a heightened awareness, understanding, and gain greater professional self-determination through the associated research on their own situation. Reflection is a way to emancipation and professional autonomy, a way to offset the conservative influences, the taken-for-granted routines that many beginning teachers meet in the school context. Prawat (1991) likened reflection to a conversation with oneself and saw it as an aspect of empowerment for the teacher (p. 740). He saw this as a way to liberate teachers from the “unwarranted control of unjustified beliefs” (p.724).

A major discussion concerning reflective teacher models has centred on student teachers (Feiman-Nemser & Buchmann, 1986; LaBoskey, 1993). In these cases reflective processes were used to help student teachers confront their beliefs and move from ‘common sense thinkers to pedagogical thinkers’ (Feiman-Nemser & Buchmann, 1986). Others, including Wilcox, Lanier, Schram and Lappan (1992), have used teacher reflection as part of a larger case-method model with experienced teachers. Discussion of the case methods model, as another way to develop teacher empowerment, follows in more detail later in this chapter.

Clarke and Peterson (1986) commented that student teacher reflection is often at a superficial level, in that they do not probe deeply into issues or situations. According to Clarke and Peterson, this superficiality is possibly because the student is giving too much attention to delivery of material and content with a consequent limited time for consideration of how the lesson or activity is going. Kagan (1992) similarly observed that expectations required of novice teachers were frequently too high, which in turn overwhelmed them, and this coupled with their lack of procedural knowledge meant they had no time to engage in introspection. Other factors resulting in superficiality could be confidence, as student teachers cannot detach themselves from their own practice to allow themselves time to think about teaching critically and objectively. Further, student teachers often lack the necessary analytical skills to examine their own practice. Calderhead (1989) noted that many teachers need time to acquire reflective as well as



analytical skills. The present practice in many schools of ‘throw them in at the deep end’ places an overriding emphasis on survival and does nothing to develop reflective practices. Bullough (1991) also noted that the newly qualified teachers are frequently poor judges of their performance, reacting in overtly sensitive ways to the opinions of pupils, peers and parents. A model for professional development is needed which aims to help beginning teachers identify and develop in practice the metacognitive strategies necessary for reflection on their practice. This appears to be one way to have beginning teachers consider critically their beliefs and the taken-for-granted practices of their context. They then generate their own knowledge and beliefs rather than perform as a consumer of beliefs, which are already in a finished form. Specific approaches commonly used to help teachers reflect on their practices are action research and case methods meetings, both of which are discussed in more detail here.

### Action research model

The first model for working with teachers within an empowerment paradigm discussed, is action research. The use of the action research cycle is a popular method employed by researchers considering classroom setting and change that provides for teacher empowerment (Elliott, 1978; Grundy, 1998; Kemmis & McTaggart, 1988, 1992; Reeves, 1990). An action research model involves a cycle of stages, beginning with the identification of a problem or issue. This first stage directly involves the teacher or group of teachers, as it is the teacher who identifies the problem to be resolved. The problem directly relates to the context of the teacher’s classroom. Once the problem is identified, then the next stage of the cycle can be instigated. Now the teacher and the researcher have to decide what will happen in the classroom or elsewhere in order to resolve the problem. This plan of action then operates in the classroom with appropriate methods of observation and data gathering. The analysis of the data will form the next part of the cycle. At this point decisions are made, via a process of reflection, as to the appropriateness and effectiveness of the action. Further issues or problems identified as a result of this analysis then form the focus for a second spiral of the action research cycle.

Kemmis and McTaggart (1992) have noted that action research “is not research done on other people. Action research is research by particular people on their own work, to help them improve what they do, including how they work with and for others” (p. 22). Thus, action research keeps within the confines of empowerment as, under this approach, teachers initiate the action: they, rather than an outside agent, are in charge of any change that takes place.

The following statement of the purpose of action research was put forward by Kemmis and McTaggart (1992):

[Action research is] a form of collective self-inquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out (p. 5).

From the definition it can be seen that action research has a purpose of trying to understand and improve a particular situation and, as such, is grounded in the constraints and complexities of that situation. Grundy (1998) offered a brief but useful statement about action research when she wrote, “The aim of action research is *improvement* grounded in the principle of *participation*” (p. 16). Ellerton (1996) noted that an externally based researcher can observe the impact of action research on the classroom, but it is the teacher who gains the understanding of the classroom. Another important aspect of action research is the use of the action research cycle, as noted earlier. This cycle consists of four stages—plan, act, observe and reflect. The last part of the cycle, reflection, incorporates one of the main aspects of professional development. Clarke and Peter (1993) identified these as teacher reflection and teacher experimentation. The cycle uses, in its second stage, the other important aspect, that of teacher experimentation.

Work by Ellerton, Clements and Skehan (1989), Gallos and Herrington (1999) and Herrington, Sparrow and Swan (1995), used the action research cycle with an emphasis on the *insider* (teacher) rather than the *outsider* (researcher, curriculum leader) setting the agenda for discussion and development. These researchers maintained that the action research cycle of plan, act, observe and reflect was central to the work of teachers. The design of the projects established the need for reflection and experimentation by teachers

and set the problem in a specific context and a real classroom. This made it a compatible model for use with the principles of teacher empowerment.

Kemmis and McTaggart (1988) have stressed the need for action research to be a collaborative and collective process, that is action research is not individualistic. In that sense, the true action research model does not fit comfortably with the context of working with individual teachers. Teachers are, for the majority of their time, isolated from professional colleagues, and in a context requiring decisions and actions that are immediate and complex.

Johnston (1994a), and Johnston and Proudfoot (1994), however, questioned the role of the action research cycle with teachers from the point of view, they asserted, that it is not a normal thing for teachers to do. They argued that action research, in its true form, is not a natural approach for teachers in that it requires them to be systematic, collaborative and critical. These, they suggested, are not features of teachers' usual approaches for reflecting on and improving their practice. Thus, if one is hoping to establish long-term change then, methods, which are more akin to teachers' natural processes, might be more successful.

The action research cycle does, however, provide a useful model for working as it gives a basis to incorporate both teacher reflection and teacher experimentation that is context specific. This last aspect of the cycle (reflection) is most important as generally the beginning teacher, and for that matter more experienced teachers, are often unable to find time to reflect in the busy world of the classroom.

### Case methods model

For many years, the study of specific cases has been part of the teaching and learning processes in business, law and medicine. Here teachers use the 'messiness of reality' to offer 'windows on practice' from which the learners can re-examine that practice and construct their understandings (Merseeth (1996). Shulman (1991) and Doyle (1990) noted the potential for case methods in education with the shift of emphasis from a preoccupation with behaviours and skills, to a concern for complex cognitive processes.

The use of case methods provides teachers with opportunity for reflection without the problems associated with field experiences (Moje & Wade, 1997).

Case methods in mathematics education (Barnett, 1992; Barnett & Friedman, 1997; Barnett & Tyson, 1993a; Clarke, 1996; Tyson, Barnett & Gordon, 1995) provide a useful opportunity for teachers to expand their pedagogical thinking and reflection on practice. They are provoked to re-examine their perspectives on teaching. By prompting teachers to analyse situations or cases and argue the benefits and drawbacks of various alternatives, cases can play a critical role in expanding and deepening pedagogical content knowledge, which, in turn, helps children's learning. Instead of separating theory and practice, working with cases provides a bridge relating them in context. Shulman in her introduction to Louden and Wallace (1996) suggested that case methods:

Can prepare teachers to become problem solvers who pose questions, frame and reframe problems, explore multiple perspectives and examine alternative solutions (p. iii).

More importantly, she asserted that "case based teaching can help neophytes learn to think like a teacher and promote communities of learners among veterans" (p. iii). Cases provide a context for reflection-on-practice (Schon, 1983) by teachers. They help teachers be more reflective, more collaborative and more deliberate in their plans for improvement of their teaching and learning activities (Louden & Wallace, 1996). They provide a vehicle for the teacher to encounter teaching realities and learn how to translate the emerging knowledge into professional practice. Teachers are able to distinguish between the immediate crisis and the underlying problem (Herman, 1998). In this sense, case method meetings appear to be a most suitable vehicle to engage new teachers in thinking about their practice, with the benefit of support from other professionals.

Participants write the cases based on classroom incidents and teaching dilemmas or they are gathered from the literature. These cases or teacher stories report critical incidents, controversial situations and dilemmas experienced in the classroom and form the basis and focus for discussion between participants. The structure of case discussions maximises teacher direction and control. A facilitator leads the discussions and asks teachers to clarify or elaborate their ideas, justify their positions, and critically examine

alternative perspectives. From these discussions, teachers are more able to take a critical stance on issues, their practice and develop the necessary skills for a considered appraisal of situations.

Barnett (1992) noted that an approach, such as case methods meetings, is effective in assisting people to acquire advanced knowledge, particularly in a complex, content-dependent, and ill-structured domain such as teaching. This approach, Barnett argued, was very similar to other prevailing psychological theories—namely, situated cognition and constructivism—in that it did not decontextualise knowledge and did not rely heavily on generic or theoretical abstractions. In accordance with Spiro's work, she argued that vignettes criss-crossed the domain of primary school mathematics teaching and learning and interwove variations of the same issues in different cases. Major elements appeared in many cases and caused teachers to retrieve, understand and grapple with them in different contexts and under different conditions. This, Barnett argued, simulates the way teachers access and use knowledge in real situations. Barnett and Tyson (1993b) noted a strengthening of teachers' mathematical content knowledge and pedagogical knowledge because of participating in case methods discussions. They suggested that this is an essential factor in developing a sense of internal authority and autonomy for the teachers. The idea of teachers learning about teaching in social ways develops a community of learners and parallels the work of Lave and Wenger (1991) and Adler (1996) on the social nature of learning. Developing a community of learners via case methods meetings would be one way to overcome the feeling of isolation of many beginning teachers. Once teachers become empowered they seem eager to empower their own students in a similar way (Barnett & Friedman, 1997). Empowering students is an underlying principle of modern approaches to teaching mathematics in the primary school.

### **Human support in professional development**

The provisions of support for the beginning teacher must take into account the dynamic factors that are, firstly, specific to the individual and secondly, specific to the teaching environment and the tasks to be accomplished (McNergney & Carrier, 1981). In other

words, any intervention must be individualised to address the unique characteristics and experiences of the beginning teacher.

The isolation of the beginning teacher needs to be addressed by the human support offered. Teachers working alone in an area of uncertainty, such as the first year of teaching in a new school, often rely on a mixture of ‘idiosyncratic experiences and personal synthesis’ to solve problems (Feiman-Nemser & Floden, 1986). Unfortunately, when personal experiences do not help teachers solve students’ problems, they may shut down and seek ways to protect their identity in the classroom, such as refusing to try new techniques (Brown, Yeager, Rennells & Riley, 1997). In addition, they may question the viability of those practices (Hargreaves, 1992).

When one considers how one might proceed with the idea of helping beginning teachers with the process of reflection on and developing the effectiveness of their classroom practice, then one needs to think about the role of the ‘other’. A number of methods adopted at the classroom level are available from the research literature, for example, mentoring, demonstration teacher, school support teacher and fellow worker. The section that follows discusses the merits and appropriateness of some of these models. First, however, it is pertinent to consider the sort of support needed by beginning teachers before considering how to offer the support.

The work of Gold (1996) and her recent review of the literature of beginning teacher support have been influential on the structure of this section. She noted that in many instances of beginning teacher induction into the profession there has been no support. Where there has been support, the literature reveals a shift from the notion of a mentor teacher or expert to one of a support provider who assists a new professional colleague. Both these roles form the basis for discussion in more detail, later in this section.

### Beginning teacher needs

Generally, the beginning teacher needs comprehensive but varied support, both in professional and personal, inside and outside of the classroom, matters. For many there is an initial idealism about teaching and unrealistic expectations of children (Rust, 1994)

which are quickly subjected to the reality shock (Veenman, 1984) of the real world of the classroom. Often beginning teachers are given some of the more difficult classes or situations as their first appointment (Gold, 1996). Lave and Wenger (1991) have written in a more general sense:

Conditions that place newcomers in deeply adversarial relations with masters, bosses or managers; in exhausting over involvement in work; or in involuntary servitude rather than participation, distort, partially or completely, the prospects for learning in practice (p. 64).

Little wonder then that, for many, disillusionment and feelings of inadequacy soon set in and the beginning teacher often finds it difficult to cope with the multitude of pressures encountered each day (Veenman, 1984). Thus, there is a need to develop within beginning teachers a sense of confidence and a positive self-concept related to themselves as an effective teacher.

From an instructional and professional point of view, Veenman's (1984) work is a benchmark. He identified the perceived needs of beginning teachers from an extensive review of the literature as:

- assisting in disciplining pupils;
- motivating them;
- dealing with individual differences;
- assessing work;
- dealing with parents;
- organising class work; and
- obtaining materials and supplies.

There is no evidence from the literature to suggest that these features do not hold true for modern beginning teachers of mathematics in the primary school.

Feiman-Nemser (1992) felt that teachers needed help with curriculum and instruction issues as these, she argued, were the cause of the management and discipline problems that were noted by the majority of beginning teachers. To this list has been added subject matter knowledge, that is the content of the lesson taught (Shulman, 1986).

If one now considers the personal needs of the beginning teacher then the work of Bolam (1987) is influential. He offered the following personal factors impinging on many beginning teachers:

- physical fatigue;
- stress;
- financial worries;
- loneliness;
- lack of self confidence;
- isolation; and
- disillusionment.

Within the Western Australian system many beginning teachers are appointed to remote schools in the State which are vastly different to anything experienced by most student teachers during their university teaching practice. Not only are the schools different but the lifestyle is a huge challenge for many teachers who, up to this point, had lived in their family home with their parents and had had an established circle of friends for support.

Gold (1996) noted critical issues and persistent concerns. Many support programmes, she argued, are closely associated with training regimes and are underpinned with the idea that the thinking and behaviour of the beginning teacher can be imposed upon by others. She contrasted this methodology with programmes which “addresse[d] teachers’ individual and professional needs” (p. 578). Thus, support should concentrate on the unique qualities of teachers and focus on developing teachers’ identities and their competence as individuals who are also teachers. This statement echoes principles noted from the discussion of principles for professional development of teachers earlier in this chapter. At the classroom level, support should account for the needs of the individual. The needs can be considered under two general groupings, that of pedagogical and personal. Teachers should identify their unique needs rather than have a generalised version of needs imposed on them by an outside agent based on generalised findings related to all beginning teachers.

The literature suggests that case methods and action research are potentially powerful methods of supporting the development of beginning teachers. The use of case methods



appears to be a model for reflection on contextualised practice as well as a vehicle for developing understandings through a community of learners. Action research methods will allow beginning teachers to identify their concerns, and so empower them to attend to their problems, with the support of other professionals. These methods can engage beginning teachers in ‘experimentation and reflection’ on their pedagogical practice and thus provide both components for development, as noted by Clarke and Peter (1993). A major question that remains, however, relates to the role of the researcher. How can support be given to the beginning teacher in the classroom via the models and principles outlined earlier? How can this be achieved without adopting a transmission mode? Associated with the debate is a further question related to the appropriate role for the researcher, as the same person will undertake both supporter and researcher roles. Discussion of the role of researcher follows in more detail in Chapter 5 on research methodology. The next section discusses methods that have been used to support beginning teachers at the classroom level.

## Mentor

One of the support roles for beginning teachers is that of a mentor. There is a growing consensus that mentoring contributes to the competency and motivation of beginning teachers (Dowding, 1998; Huling-Austin, 1990; Lane & Canosa, 1995). A definition of mentoring is given as:

a nurturing process in which a more skilled or more experienced person, serving as a role model, teaches, sponsors, encourages, counsels and befriends a less skilled or less experienced person for the purpose of promoting the latter’s professional and/or personal development. Mentoring functions are carried out within the context of an on-going, caring relationship between the mentor and protege (Anderson & Shannon, 1988, p. 38).

Krupp (1987) suggested that mentoring is the process by which a trusted and experienced person takes a personal and direct interest in the development and education of younger or less experienced individuals. In this way, the transition from trainee to full-time teacher is eased. Little (1990) and Feiman-Nemser and Parker (1993) identified two distinct roles of mentors. First, mentors may provide social emotional support where the novice is initiated into the ways and workings of a particular school and second, and

more significantly, mentors may provide professional support. Here the role is to foster a principled understanding of teaching. In this second role, the emphasis is on not only helping teachers learn to teach but also on learning how to reason about, and learn from, teaching. Thus mentoring becomes a vehicle for teacher development. There are, however, some aspects of mentoring models that do not match with principles of beginning teacher support outlined earlier.

Feiman-Nemser (1992) drew a distinction between two aspects of the professional development role of the mentor. In much of the literature on mentoring, she argued, there is an emphasis or a tendency toward the mentor being the expert to be imitated. In this model, the mentor shows or tells how something should be done and the beginning teacher is expected to follow and adopt the prescribed way. This model, as noted earlier (Gold, 1996), has been criticised as it does not cater for the growth and understanding of individual teachers with their problems and experience. A more helpful way for the beginning teacher to develop is via problem solving carried out in a genuinely collegial atmosphere rather than a system of advice on crisis management or the dispensing of 'tricks of the trade' meant to provide immediate solutions (Peterson & Williams, 1998).

Hart (1989) has identified a further difficulty with some mentor programmes. Here it is noted that the conservative traditions and social organisation shape the mentor role. The norm of teacher isolation means that many skilled teachers have little experience communicating with other teachers about their practice. The conservative norms of teacher interaction make it difficult both for mentors to critique the work of beginning teachers, and beginning teachers to request help with problems in their classroom (Little, 1990). Thus, often the role of the within-school mentor is limited to providing information about the system, rather than consultation on curriculum and instruction (Odell, 1986) and asking tough questions about practice (Little, 1990). There is, in addition, a tendency to continue or impose the traditional practices of the school rather than offer support for personal development and innovation.

The role of the supervisor/mentor has overtones of evaluation and the monitoring of performance. Feiman-Nemser and Parker (1993) described a mentoring project in Los Angeles, which had an underlying agenda, that is, to make sure that the job was done in

the way the State said it should be done. It was more assessment than assistance-orientated and did not allow, in explicit ways, for the personal growth of the individual. This is the case when beginning teachers are subject to assessment during their first year of teaching. Often the mentor becomes the evaluator of the beginning teacher. This adds a tension to the relationship and interactions between the beginning teacher and mentor and removes the possibility of 'risk taking' by the beginning teacher. Teachers adopt 'safe ways' of teaching to avoid the risk of failing or making a mistake in front of the assessor.

Another contrasting view of the role, which Feiman-Nemser termed 'support teacher', was to facilitate a process of personal professional development for the teacher. The 'support teacher' helped beginning teachers learn how to reason about and learn from their own teaching. It was achieved through working in the context of a professional learning community (Feiman-Nemser, 1992). The next section discusses the idea of a 'support teacher'.

## Support teacher

The role of the experienced teacher is not only to help the novice to survive the first year of teaching, but also to learn from that experience. Feiman-Nemser (1992), Feiman-Nemser and Parker (1993) described case studies of Pete Frazer and other support teachers. They noted the central tensions between personal expression and professional accountability, between the unique qualities of the individual teaching style and the shared understanding of what constitutes good practice (Feiman-Nemser 1992). The support teacher had to guard against the two dangers of imposing a personal style and being too laissez-faire and allowing an 'anything will do' attitude. This delicate balance had to be achieved to allow for the sharing of knowledge, as well as to encourage the beginning teacher to construct a vision and philosophy of what it is to be an effective teacher. The idea of a co-thinker seemed appropriate for a situation where experiences from teaching were shared, new ways, new perspectives and options for action were offered but solutions to problems were not given. It is this idea of options for action rather than solutions to problems that is crucial to supporting beginning teachers.

Clarke (1996) has described a role that, in fact, parallels much of the notion of a support teacher of Feiman-Nemser discussed earlier, as ‘fellow worker’. He considered the role of the researcher or visitor to be important in that it offered the opportunity to the teacher for reflection during and after the classroom event. The researcher, in Clarke’s study and in work by Nolder cited in Jaworski (1993), became a support person or ‘fellow worker’. The ‘fellow worker’ took part in informal discussions and became a form of sounding board for the teacher—an audience for the teacher’s thoughts.

Brookfield (1987) suggested the role of critical friend as being a person who identified, questioned and challenged assumptions held by the teacher or were present in the context. The critical friend attempted to explore alternatives; to consider what was the norm in this instance but was not so elsewhere; to identify fixed belief systems, habitual behaviours and entrenched social structures. Teachers are gently challenged to justify their position and to offer supportive evidence for their stance. In the search for alternatives and for justification of decisions, the critical friend can adopt this stance and so help the forward movement of the teacher’s thinking.

One of the roles of the support teacher is to help beginning teachers make their ideas personal and exposed (Hogan & Down, 1998). Easen (1985) highlighted one of the guiding principles for the support teacher when he wrote:

You cannot change other people, nor can they change you; people can only change themselves. The best that anyone can do is to provide a structure, which helps others to change, if that is what they want to do (p. 71).

## Summary

The act of reflecting may be thought of as the missing link between experiencing and learning from that experience. Many beginning teachers have the experience but miss the meaning in their concern to survive. This is a criticism offered against so many of the experience or apprenticeship models (Feiman-Nemser 1992) where imitation rather than personal growth is the tendency. Other studies (Cochran-Smith, 1991; Griffin, 1989) showed that students perceived very little connection between the experience in the classroom and the theory of the university course. Many teachers discussed only

procedural knowledge or constructed personal theories from single case examples. Wider options for action, developed through reflection with an experienced teacher are needed to produce deeper and richer knowledge of pedagogical practice.

A number of important points emerged from the literature in relation to developing change in classroom practice and in supporting beginning teachers to undertake this change. In relation to change, it appeared that teacher reflection and teacher identification of the change were central facets. Closely related to these is the idea of teacher experimentation. By 'trying something out for themselves' in their classroom, the teacher provides the evidence and data for reflection. The issue for reflection needs to be related directly to the context of particular teachers. In this sense, teachers are more likely to use a teaching style or activity they have demonstrated works for them, rather than use results suggested in research journals or by someone else. These points are consistent with the empowerment paradigm identified by Robinson (1989). By experimentation, the teacher can provide evidence for reflection and it is through classroom experimentation that teachers can explore whether changes enhance student learning (Clarke & Peter, 1993; Robinson, 1989).

Visits and interactions of a professional development support teacher can overcome the isolation of the teacher. Efforts to foster teacher change and teacher learning should be more appropriately construed as social collaboration, as learning is far more contextual and social than earlier models suggested (Lave & Wenger, 1991). The role of the researcher or outsider, however, needs to be one of an equal rather than superior nature. In Clarke's (1996) 'fellow worker' or Feiman-Nemser's (1992) 'support teacher', it is noted that in order to be consistent with the teacher empowerment model, the outsider has to be more concerned with choice than with change (Robinson, 1989). An outsider has also to beware of reinforcing his or her self-image, irrespective of the needs and wishes of the teacher (Begg, 1996). The supporter should encourage teachers to recognise and take responsibility for the choices underlying their own behaviour. Part of the task of the 'fellow worker' is to bring to the surface beliefs held by beginning teachers, so they may be examined by the teacher in the context of the classroom (Hogan, 1998).

## **A Professional development model to support beginning primary mathematics teachers**

There are a number of models and techniques of operation which will support the principles of empowerment and effective professional development as identified earlier. These will form a framework for the support and development of the beginning teacher. The action research cycle embodies the reflection and experimentation aspects, necessary for change (Clarke & Peter, 1993). Where this is coupled with more natural teacher methods of narrative (Chapman, 1993; Clandinin & Connelly, 1996; Johnston, 1994b) action research will support reflection-on-action and change. Case methods will allow for the interaction with fellow beginning teachers and produce a wider perspective on teaching as well as the development of critical thinking skills (Barnett, 1992). The major vehicles of action research, case methods and teacher reflection with ‘support teacher’ have been selected specifically for their ability to be consistent with the principles identified by Clarke and others noted earlier. The next section will discuss the issues of teacher reflection on practice and teacher construction of knowledge in more detail and show how they are related to the development of change in pedagogical practice.

### **Teachers reflecting**

Schon (1983) has used the term *reflection-in-action* to describe a continual process in which teachers are engaged in reflection during their teaching and interactions with children in the classroom. He also noted the idea of *reflection-on-action*. This action occurs after the event and is assisted by a collaborative process. One of the aims of this study is that teachers involved will broaden their own content and pedagogical knowledge base. They will confront, in addition, the web of their understandings and assumptions, through the process of reflection and inquiry, the two principles put forward by Clarke and Peter (1993) and noted earlier. Thus, the professional development model will produce not only skilled practitioners but also “reflective professionals disposed to examine their teaching and their students’ learning critically” (Shulman, 1998, p.515).

The most formidable challenge to anyone in a profession is not applying new theoretical knowledge but learning from experience. ...Therefore, members of a profession have to develop the capacity to learn from the experience and contemplation of their own practice. ...The professional must

learn how to cope with those unpredictable matters and how to reflect on their own actions. Professionals incorporate the consequences of those actions into their own growing knowledge base (Shulman, 1998, p.515).

Discussion of this growing knowledge base in teachers is the next part of the outline of the structure of the professional development support model for beginning teachers.

### Teachers constructing their knowledge base

Many of the reform documents and curriculum statements (DEET, 1989; NCTM, 1989, 1991) described learners as active constructors of knowledge and mathematical meaning in a social context, rather than as passive recipients of transmitted facts from others. The model for supporting beginning teachers involved in this study will use a similar principle, that is teachers are constructors of their knowledge. Reflection on everyday experiences in the classroom will be used as a vehicle to help beginning teachers construct understandings of the teaching process (Barnett & Sather, 1992; Clarke, 1996). In this sense, the support model had an emphasis on meaning making by the beginning teachers. The learners actively engage in the process of constructing viable meanings within the framework established by the teacher and the 'fellow worker'. The model for support has to account for the fact that learning is a highly personal experience, and that learners build from that experience in their own ways, by filtering it through a series of personal experiential constraints (Gann, 1993). Cobb (1994) has suggested that children learn as a process of both constructivism and enculturation. Cooney (1994) complemented Cobb's synthesis of constructivism and situated cognition and broadened it to include teacher education. Frykholm (1998) applied the same idea of combining constructivist and sociocultural theories to work with beginning teachers. The model for support of beginning teachers, under discussion, uses the same underlying philosophy and steers away from the notion of replicating the performances of others or acquiring knowledge transmitted by instruction.

### Developing teachers' beliefs about mathematics teaching and learning

Teacher beliefs, as noted in Chapter 2, have an influence on pedagogical practice. Part of the process of construction of knowledge by teachers must allow them to reflect on their

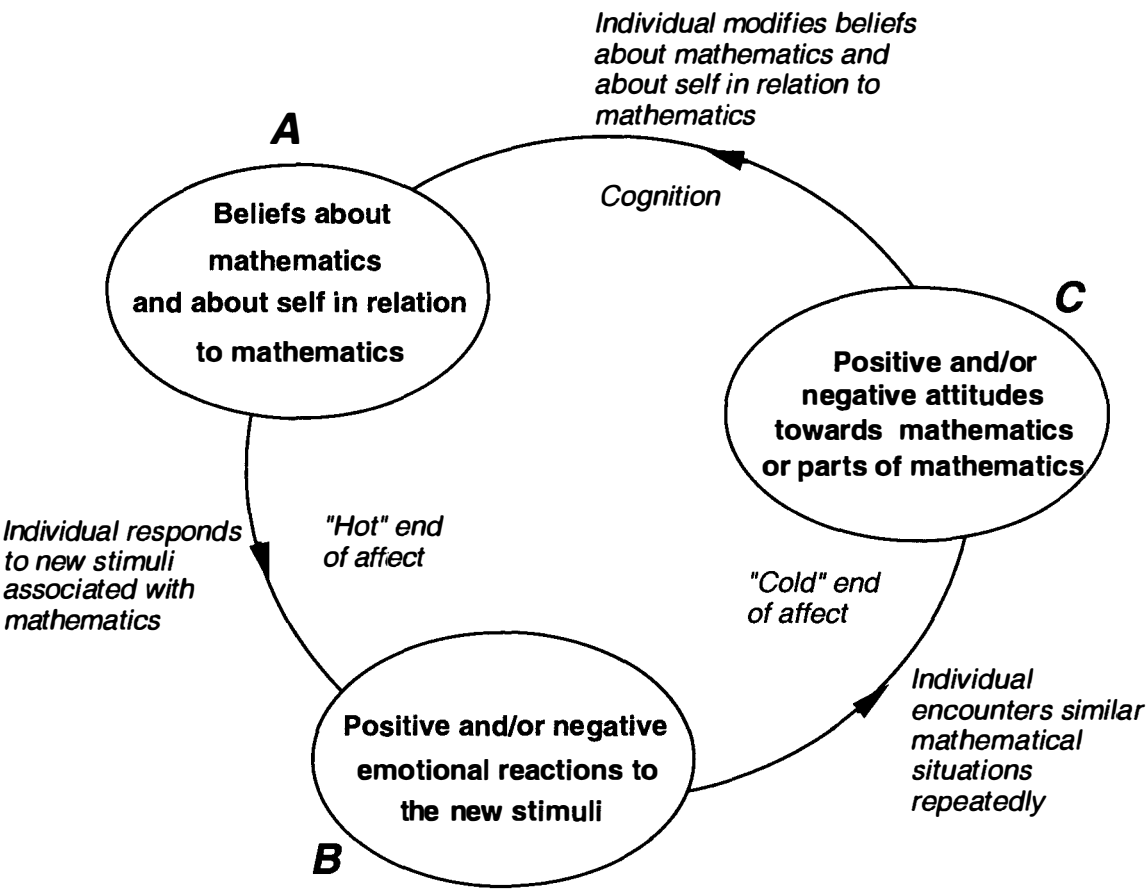
beliefs. Clarke (1995) suggested that Thompson's statement regarding teachers' beliefs and practices could be extended to say, "consistency between teachers' beliefs and practice depends largely on their tendency and opportunity to reflect on their actions" (p.179). The support model under discussion established that tendency by giving teachers, in the first year of teaching, the opportunities, choices and skills to reflect on their practice and become critical, autonomous and reflective thinkers.

Leder (1992) cited in Ellerton and Clements (1994) discussed the term 'attitude' and stated that attitudes are learnt and that they predispose people towards action. These attitudes can be either favourable or unfavourable. Ellerton and Clements (1994) discussed attitudes and beliefs and in particular the work of Mandler and McLeod. From Mandler and McLeod's work they emphasised the notion that emotions can give birth to attitudes which, in turn, if reinforced over time, become firmly-held beliefs. There is, therefore, a continuum of emotions to attitudes to beliefs. These beliefs are, therefore, much harder to influence and change and in many cases lead to habitual action.

In their discussion, Ellerton and Clements developed a model summarising this development (Figure 3.1).



**Figure 3.1 : Development of beliefs and attitudes (Taken from Ellerton & Clements, 1994)**



The model presented in Figure 3.1 implies that, if any influence is to be achieved on the belief system of teachers, and subsequently on their classroom practice, one would need to intervene at the attitude and emotion end of the cycle (the ‘Hot’ end). This would have to be done before the attitudes become beliefs at the ‘Cold’ end, where they are more resistant to change. Beginning teachers of mathematics may meet new experiences in their first classroom and may have an emotional reaction to them which, in turn, may lead to a positive or negative attitude to the incident. If one wishes to develop the positive aspect of these reactions, then it is important to have positive emotional reactions, which occur in a number of ways, including with the help of a ‘fellow worker’, to interact with the beginning teacher at this point.

## Characteristics of the support model

The aim of the proposed support model for beginning teachers is to develop teachers who are adaptive learners and who have the skills to attain competence and information when the need arises. In summary from the literature, it appears that in successful professional development two themes emerge. First is the importance of helping teachers to become reflective professionals who continue to learn and change in thoughtful ways. Change requires ongoing reflection on practice and underlying assumptions. Learning to teach is a life-long process—a continual growth model (Borko & Putnam, 1998; Gratch, 1998). The second theme emerging is the importance of learning communities who play a crucial role in fostering reflection. Essential features of the support model for beginning teachers are contained in Table 3.5 below.

**Table 3.5 : Features of the professional development support model for beginning teachers of primary mathematics.**

- |   |  |
|---|--|
| 1 | The beginning teacher is empowered to decide which problem or issue will be the focus of attention (Begg, 1996; Clarke, 1994; Cooney, 1996; Knowles, 1984; Louden, 1994; Robinson, 1989)   |
| 2 | The beginning teacher is empowered to decide what will happen in the classroom or elsewhere to address the problem or issue (Clarke, 1994; Knowles, 1984; Louden, 1994; Robinson, 1989; Speck, 1996)   |
| 3 | The fellow worker will be an experienced teacher (Clarke, 1996; Feiman-Nemser, 1992; Speck, 1996)  |
| 4 | Options for action will be decided between the fellow worker and beginning teacher but the beginning teacher will choose which option to put into action (Feiman-Nemser, 1992; Knowles, 1984)  |
| 5 | The model will be based on and in the specific context of the beginning teacher  |
| 6 | Reflection on practice and beliefs of the beginning teacher will be emphasised (Clarke, 1994; Clarke & Peter, 1993; Easen, 1985; Hogan & Down, 1998; Louden, 1994; Prawat, 1991; Pultorak, 1996; Raymond & Santos, 1995; Schon, 1983; Speck, 1996) |
| 7 | Experimentation in the classroom will be encouraged to provide data and evidence for reflection (Clarke, 1994; Clarke & Peter, 1993; Louden, 1994)   |
| 8 | Meetings with other beginning teachers will be established (Adler, 1996; Barnett, 1995; Clarke, 1994; Gordon & Tyson, 1994; Lave & Wenger, 1991; Louden, 1994)   |
| 9 | Beliefs and assumptions about mathematics and mathematics teaching and learning will be exposed (Hogan, 1998; Thompson, 1992)  |

While the literature provides many useful insights into professional practice and development, there are some significant gaps in published research and reports. In

particular, there is little which describes in detail the influences that effect the beliefs, pedagogy and practice of the specific target group of the current study: beginning teachers of primary mathematics. Elements of similar techniques of using a 'fellow worker' can be found, as noted, in the work of Clarke, (1996) and Feiman-Nemser, (1992). In addition, there is no evidence of a systematic evaluation of the usefulness of a professional development support model as a means of encouraging positive change in the pedagogical practice of beginning teachers of primary mathematics. These areas form the basis for the research questions used in this study.

The following section presents the main research questions considered in the project designed to investigate factors influencing the practices and beliefs of beginning teachers of mathematics and the effect of a professional development support model on those practices and beliefs.

## **The research questions**

From the previous discussion of the research literature on factors influencing the pedagogical practices of teachers and the principles for supporting the professional growth of teachers, it appears that there are questions related specifically to beginning primary mathematics teachers which need to be asked. The following research questions are identified for this study:

The first two questions relate to factors influencing beginning teachers' pedagogical practices and beliefs. These are as follows:

### **Research question 1**

To what extent do the following personal and contextual factors influence the pedagogical practices of beginning teachers in mathematics teaching in the primary school:

- previous school experience;
- teacher education course and school experience;

- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- beliefs about mathematics, teaching and learning mathematics;
- time constraints;
- children’s reactions and behaviour;
- the beginning teacher’s education;
- professional development;
- the researcher; and
- other sources?

A major factor influencing teachers’ pedagogical practice according to the literature is that of their beliefs about mathematics, its learning and its teaching. A second question is designed to ascertain factors influencing beliefs related to how mathematics should be taught.

## Research question 2

To what extent do the following factors influence the pedagogical beliefs of beginning mathematics teachers in the primary school:

- previous school experience;
- teacher education course;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children’s reactions and behaviour;
- the beginning teacher’s own education;
- professional development;
- the researcher; and
- other sources?

A third research question considers the professional development support model designed and used with the beginning teachers.

### **Research question 3**

To what extent is an empowerment model of professional development, with ‘fellow worker’ support, an effective way to help beginning teachers develop as professional teachers?

The next chapter will outline and justify the methodologies used to gather data related to the research questions. Information is provided about the subjects of the investigation, their background and the context of their first year of teaching.

## Chapter Four

### Methodology

#### Introduction

The primary goals of this study were to describe beginning teachers' emergent knowledge, beliefs, thinking and action related to mathematics teaching in the primary school and to examine the impact of a professional development support model on the process of learning to teach in the first year in school. This was to happen as they experienced the professional development support model during their first year of teaching primary mathematics. Added to this was an aim to understand the interdependence and mutual influence of these components of teaching and learning to teach. The research questions seek to understand the nature of a learning environment and the ways in which the beginning teacher interacted with it. That is the researcher wished to elucidate the internal dynamics of relationships and situations. It was not a controlled experiment, but a naturalistic enquiry since the "researcher [did] not attempt to manipulate the research setting" (Patton, 1990, p. 39). Qualitative methods, being inductive in nature, have the potential to allow for the development of analytical, conceptual and categorical components of explanation from the data. Assumptions of a general nature related to qualitative methodologies are outlined as follows:

#### Qualitative designs:

- emphasise meanings, context and interpretation from the perspective of the participants rather than view behaviour as being informed through objective facts;
- purport to understand the processes rather than find a causal relationship; and
- have the researcher actively involved rather than attempting to minimise impact. (Firestone, 1987).

Thus, the main methodology adopted was that of interpretative research, whereby the researcher tried to understand behaviour by observing people and by eliciting from them

the meanings they attached to actions and events. These points support the use of qualitative methodologies in this, mainly interview based, study (Patton, 1990). Qualitative methods were chosen because of their compatibility with the complex nature of the study and with the constructivist underpinning of the theoretical framework. The ranges of techniques that were used are described later in this chapter.

Procedure

Case studies were designed to identify and then track the development of five beginning teachers from the last days in their university training course, throughout their first year in school and to finish at the end of Term Four. Each case study is reported according to the five phases shown in Table 4.1.

Table 4.1 : Phases of the study

Phase	Date	Methodology
Phase 1	November 1996	<ul style="list-style-type: none"><li>• Beliefs questionnaire to whole cohort of Primary Graduate Diploma class</li></ul>
Phase 2	Term 1 1997	<ul style="list-style-type: none"><li>• Identification of participants</li><li>• Initial interview</li><li>• Repertory grid 1</li><li>• Start of action research cycle</li></ul>
Phase 3	Term 2 1997	<ul style="list-style-type: none"><li>• Two interviews</li><li>• Continuation of action research cycle</li></ul>
Phase 4	Term 3 1997	<ul style="list-style-type: none"><li>• Two interviews</li><li>• Case Methods meeting</li><li>• Classroom observation</li><li>• Continuation of action research cycle</li></ul>
Phase 5	Term 4 1997	<ul style="list-style-type: none"><li>• Two interviews</li><li>• Repertory grid 2</li><li>• RADIATE data</li><li>• Characterisation scales</li><li>• Mathematics plans</li><li>• Children's responses</li><li>• Repeat questionnaire</li></ul>

Participants in the research

There were three main groups of participants in this project: a participant researcher, a large cohort of student teachers and a small sample of beginning teachers.

Participant researcher

The role of the researcher in any investigation, be it qualitative or quantitative in design, is of importance. Generally, in quantitative research designs the researcher is not a participant in the project. This reported project, however, used mainly a naturalistic methodology requiring the involvement of the researcher. The study was conducted with the researcher in the role of ‘participant-as-observer’ (Fig. 4.1). Gold (1969) has identified four different roles for the researcher in qualitative studies. These roles are outlined below.

Fig. 4.1 : Possible roles for researchers in qualitative studies (Gold, 1969)

Complete participant	Participant as Observer	Observer as Participant	Complete observer
Identity not known to group. Researcher interacts naturally with group as a member	Participates fully with group, but identity as researcher known to group	Identity of researcher known, but no attempt made to participate as a member of the group	Researcher observes without any involvement in group activities

The group knew the researcher, and while the researcher was a member of the group, the role does not fall unambiguously into Gold’s classification. As part of the underpinning of the investigation was with constructivist and empowerment principles, the involvement of the researcher within the group was limited to offering choice. It was important for the researcher to refrain from giving opinion and taking a leadership stance. The researcher occupied an organisational and administrative role necessary to develop



the investigation. This would place him more within a 'participant as observer' role rather than within the 'observer as participant' category.

A limiting factor that had to be taken into account was that all the participants knew the researcher, as he had been their mathematics education lecturer for the previous year. This carried with it the possibility that the participants might offer only the thoughts and opinions they felt the researcher wished to hear based on their prior interactions with him. While this possible effect can never be completely negated, efforts were made to lessen the impact. Opinions were not offered, support was given only when requested, and evaluative comments and actions were withheld.

Perceptions of any situation are distorted by the presence of the researcher and, even if the person is not present, there is still the possibility of distortion because the researcher is the audience for the data. This study, as part of the discussion of limitations, acknowledged the researcher as part of the dynamics of the situation, and provided a critical appraisal of the participation and contribution to the situation. It noted especially, any areas of role conflict.

Moreover, the actual presence of the researcher and the fact that the person was 'being researched' may have an effect in that the person may do things and act in ways that are not normal for the person. The perception by the participant may be that the researcher requires certain ways of working, and hence, acts in those ways to please the researcher. However, one may assume that people cannot do things of which they are incapable (Sullivan, 1989b).

## Student teachers

The initial questionnaire surveyed the cohort of Graduate Diploma in Education primary students graduating from a Western Australian University. There were approximately 60 students. All students had an initial Bachelor's degree, while some of the group had further qualifications ranging from specialist Diplomas to Masters' degrees to one student with two Doctoral degrees. The subject specialisms varied from fine arts and media to business, optometry and accounting. The majority of the group members were female

(approximately 75%) and the ages ranged from students straight from their first degree studies to mature aged people returning after bringing up a family or making a career change. From these students, a further sample of five students was selected for case study work.

## Beginning teachers

This sample consisted of three male and two female teachers, initially. The sample is not typical of the case for the population of preservice or beginning teachers where generally males are in the minority. The need for the researcher to visit beginning teachers in school on a regular basis governed the selection of participants. Thus, proximity to the university was a factor. In reality, few teachers gained employment within a distance of 100 kilometres from the university. The five that did secure full time classroom teaching jobs agreed to take part in the study. Other Graduate Diploma students were employed on a part-time basis in specialised posts such as teaching French or music and were not deemed suitable for the investigation. No beginning teachers from other preservice courses were found in full time employment within the Perth metropolitan area.

The three males selected were older than many of the large cohort of Graduate Diploma students. One was a former plumber, one a house painter and the third a former secondary teacher. The two females were straight from their initial degree, which had followed on from their secondary schooling. More detail of the final participants is given in Chapters 5,6,7 and 8 on case studies. First the former house painter and then, in the final stages, the former secondary teacher, withdrew from the group for personal reasons.

## Context for research

Each participant was visited in school. Interviews took place there, as did teaching observations and the completion of surveys. The case methods meetings were held at the university which was in a central and convenient location for the group as, all barring one member, they returned to live in Perth at the weekend. All schools were in the primary range with a full span of K to 7 classes enrolled. Three were State schools while the other two consisted of one from the Roman Catholic system and one from the Independent

sector, being a Christian Denominational school. Two of the schools were in large towns some distance to the south and north east of Perth. The other schools were part of the Perth metropolitan area, though two were at the very northern edge of it. Details of the school settings are given in the later case study chapters.

**Research techniques**

This section describes and justifies the methods used for data collection. It describes each method and shows the relationship of the methods to the demands of the research questions. The chosen methods for data collection follow mainly those of a qualitative research paradigm. Namely, case study, transcribed interviews and meetings, repertory grids, teacher and researcher journals, classroom observation, RADIATE categories and characterisation scales. The main source of data was from interview transcripts. Data from the other techniques were used to substantiate and expand points made from the interview data. Such techniques played a supportive but secondary role to the use of interview transcripts. In the reality of data gathering there was not as much data from the secondary sources as originally planned. For example, journal data from the participants was limited, usually incomplete, and not as consistent as was envisaged. Often it was a repeat of data gathered via the informal interview which was seen as a stronger data source as it could be questioned and developed. In a similar way, data from case methods meetings represented only two of the participants and were used to confirm data from other sources.

Analysis of the transcripts of the interviews, case methods meetings, journals, and classroom observation notes was undertaken with the aid of the NUD\*IST computer program (Qualitative Solutions and Research, 1997). Factors identified from the literature as influencing pedagogy were used as the initial nodes for analysis. Other nodes were added, as they became apparent from the transcripts. Specific key words were used to search the transcripts for connections and trends. One of the results of using the NUD\*IST program to analyse the data was that often the same piece of transcript could be double or triple coded. This situation occurs in the case study reports in Chapters 5, 6,

7, and 8 where a section of speech is used to illustrate more than one point due to the complexity and interrelatedness of the data.

## Research type

The debate regarding the relative merits, often from polarised positions, of quantitative and qualitative methodologies has been in educational and other research literatures for almost twenty years. It is not proposed to resurrect that debate in any depth in this discussion. If one considers the study in question, or any study for that matter, the important point is to “select that paradigm whose assumptions are best met by the phenomenon being investigated” (Guba, 1981. p.76). The identification of an optimal research methodology for any study must take as its starting point the context and intent of the research. From this should emerge both the justification for subsequent methodological choices and the criteria by which the findings must be evaluated (Clarke, 1990). In this study, the demand is for the collection of complex data, covering multiple issues and possibly conflicting or unpredictable information. Rather than restrict the research to a single strategy, which could lead to an unnecessary restriction and a difficulty in describing the complexity of the situation, multiple strategies were used. The study needed to maximise opportunities for ‘serendipitous’ data to emerge. Qualitative methods tend to avoid restrictive outlines that would possibly miss or curtail these important happenings. In the same vein of pragmatic optimisation, the project draws on the research methods from both qualitative and quantitative paradigms. For example, questionnaire data were incorporated, to synthesise the benefits of both camps into a ‘neo-ethnography’—a middle-ground methodology (Clarke, 1990). Data obtained from more than one source is broader and potentially more valid (Sullivan, 1989b). The research design offered a broad range of data and accounted for the complexity of the situation. Another feature of the study was that of the importance accorded to the beginning teachers’ views and ideas. The study adopted a stance that it was the beginning teachers’ perception of mathematics and mathematics teaching that mattered; the accuracy or worth of this perception was not to be questioned but the origins and consistency were to be examined.

Research questions and data collection

The table below (Table 4.2) shows the relationship between the data collection techniques and the research questions. As noted earlier, some research questions will have multiple data sources to act in a cross checking way and to provide a richness of data, which is less likely to happen when only one data gathering strategy is employed.

**Table 4.2 : Matrix illustrating connections between proposed research questions and data collection.**

Research question	Rationale	Data collected	Source of data
1. To what extent do the following factors influence the pedagogical practices of beginning teachers in mathematics teaching in the primary school?	To identify actual factors from the particular context which constrain and facilitate the mathematical actions of the teacher.	Beliefs of beginning teacher about children, school, and colleagues. Practices of school and classroom. The impact of university teacher education.	1.Class observation notes. 2.Journals. 3.Interviews and informal discussions with beginning teacher. 4.Narratives from beginning teacher.
2. To what extent do the following factors influence the pedagogical beliefs of beginning teachers in mathematics teaching in the primary school?	To assess whether beliefs changed and what factors might have produced change.	Beliefs of teacher about mathematics, mathematics teaching and learning.	1.Class observation. 2.Journals. 3.Characterisation scales. 4. Repertory grids. 5.RADIATE response. 6.Pre- and post-questionnaire.
3. To what extent is an empowerment model of professional development with fellow worker support, an effective way to help beginning teachers develop as professional teachers?	To assess the degree to which the model was supportive of beginning teachers to develop reflective ways of teaching.	Actual classroom practice, rationale and justification for decisions.	1.Case methods tapes. 2.Class observation. 3.Journals. 4.Interview data. 5.Teachers' plans. 6.Children's thoughts.

Case study approach

Case study work is a popular technique in educational research settings and there is a growing body of research knowledge in mathematics education resulting from such studies. In particular, projects by (Bullough, 1990; Cooney, 1985; Desforges & Cockburn, 1987; Feiman-Nemser & Buchman, 1986; Sullivan 1989b) have adopted this technique and used it effectively to describe the complex situation of teachers.

A case study is an intensive study of an individual or group involving interaction and observation, to assess characteristics and to relate these characteristics to performance. The aim is to discover the natural processes occurring within the situation. Each case emphasises meanings which individuals hold. Case studies have been seen as primarily seeking to understand, and help teachers to understand the phenomena of classrooms. The study of cases provided opportunities to investigate the breadth of the environment of beginning teachers (Sullivan, 1989b). It was not possible within this study to focus on every aspect of the life of the beginning teacher, so only certain features, as defined by the research questions, were investigated. Case studies fall primarily within a qualitative framework because they work from within a situation, trying to explain it from a non-judgmental stance. This contrasts with the approach where the researcher stands apart and analyses from an objective viewpoint. The fact that the researcher was 'in' with the subjects could mean that there was an effect on the participants of the study. This situation is recognised and further discussion on this issue occurs later in Chapter 10.

## Interviews and phenomenology

Interviews are a useful tool for obtaining information which might be difficult to find in other ways (Patton, 1990). For example, in this study much happened in the classroom between researcher visits. Feelings and thoughts were not observable in teaching situations and beliefs established during the beginning teacher's history could more readily be gained by interview question. Interviews were used in the project as a method for providing corroboration of evidence gained from other sources in other ways (Eisner, 1991). Interviews, themselves, were cross-validated and supplemented with data from other measures that did not require the cooperation of the respondent. The study adopted a phenomenological perspective in order to interpret the interview data. Phenomenological research is "the systematic attempt to uncover and describe the...internal meaning structures...of lived experience" (Van Manen, 1990, p. 10).

Interviews can be conducted in a variety of ways: from free flowing, informal conversations to formal, set question and answer styles. Herrington (1997) provided a useful compilation of interview category type from the research literature and this table

(Table 4.3) shows the general categories from which the researcher may select appropriate techniques.

**Table 4.3 : Categories of interviews (Denzin, 1989; Patton, 1990) (After Herrington, 1997, p. 135)**

Denzin (1989)	Patton (1990)	Characteristics
Type of interview	Type of interview	
	Least structured	
	Informal conversational interview	Questions emerge from the immediate context and are asked in the natural course of things: there is no predetermination of question topics or wording.
Non-standardised interview	Interview guide approach	Topics and issues to be covered are specified in advance, in outline form: interviewer decides sequence and wording of questions in the course of the interview.
Non-schedule standardised interview		Questions and probes are determined in advance but there is flexibility in the interview, for example in the sequence of questions, depending on the response of the interviewees.
Schedule standardised interview	Standardised open-ended interview	The exact wording and sequence of questions are determined in advance. All interviewees are asked the same basic questions in the same order. Questions are worded in a completely open-ended format.
	Closed, fixed response interview	Questions and response categories are determined in advance. Responses are fixed: respondent chooses from among these fixed responses.
	Most structured	

This study adopted an interview type similar in characteristic to the *Non-schedule Standardised Interview* of Denzin and the *Interview Guide Approach* of Patton. In practice, the project did not adopt a strict adherence to either category, but took from and added to each, as circumstances dictated. This particular format was selected, as it was important on one hand to allow freedom for the beginning teachers to direct the conversation with issues of their own. On the other hand, it was necessary to ensure that important information was not inadvertently missed in the general flow of the talking. Thus, for most interviews, topics covered or questions asked of all participants were compiled in advance by the researcher. As the format of the interview was somewhat informal, the order of the questions was changed to suit the direction of the conversation. This meant that they were posed at a more natural time, and in addition, the flexible nature of the framework allowed for probing of ideas as necessary. By having some established questions, a similar range of basic information for all participants was constructed for case study purposes.

Patton’s question types formed a useful basis for the project interviews as they allowed them to access the complexity of the situation. They enabled fuller, more complex and possibly reliable answers to be given by the participants. The research questions dictated the sorts of interview questions asked. Generally, they covered all, apart from the *sensory* category, of Patton’s (1990) six types of interview questions, namely:

- experience or behaviour—about what people do or have done;
- opinion or value—about what people think of their experiences and the interpretative processes;
- feeling—about emotional responses to their experiences;
- knowledge—about factual information;
- sensory—about what is seen, heard, smelled, touched and tasted; and
- background or demographic—about respondent's age, occupation etc. (pp. 290-293)

Table 4.4 outlines the questions used in this study, how they match Patton’s categorisation of questions and comments on their purpose.



**Table 4.4 : Interview questions used in the project**

<b>Question</b>	<b>Patton type</b>	<b>Purpose</b>
What do you think influenced your beliefs about mathematics teaching?	2	Opinion question to continue the process of exposing beliefs.
In what ways has working with me on this project changed or developed your work in mathematics teaching?	1	Question used to initiate reflection by the teacher and to highlight positive features of the teaching.
Is teaching mathematics the same as teaching other subjects?	2	Opinion question to initiate reflection and question assumptions about practice.
How would you describe the mathematics learning environment in your classroom?	4	Factual information leading to reflection.
How did you feel about mathematics in your primary school days?	3	Feeling question to identify influences on beliefs.
Typically, what would a child do in your mathematics classes?	1, 4	A question to initiate reflection about what is actually happening.
What do you think are effective ways to teach mathematics? Generally? With your class?	2	Opinion question to probe beliefs about mathematics teaching.
How do you think you have changed as a mathematics teacher? Over the term? Over the first year?	1, 3	A question to highlight the positive nature of development.
What would you have done in my role?	2	Question to find reaction to the support model being used.
What support would you have wanted from other people?	2	Looking for influences on pedagogical practice and the value of the support model.
Tell me about the successes you have had.	1	Using positive aspects of the class to develop reflection and change.
What constraints to teaching mathematics do you feel there are in the school?	3, 2	Attempting to identify factors from the context that impinge on teaching.
What are the mathematics expectations of the school?	4, 2	Attempting to identify factors from the context that impinge on teaching.
What difficulties do you feel there are, with regard to teaching mathematics?	2	Identifying factors which influence teaching.
What would you like other staff to say about your mathematics teaching?	3	Probing beliefs about mathematics and teaching.

Table 4.4 continued

How do you see your role as a mathematics teacher in the primary school?	2, 3	Probing beliefs about mathematics and teaching.
How have the children reacted to your mathematics teaching?	3, 1	Identifying factors which influence teaching especially context.
What problems or frustrations with mathematics teaching have there been this term?	3, 4	Identifying factors which influence teaching especially context.
What aspect of mathematics teaching do you want to look at first?	4	Starting the action research cycle and empowerment model of support.
What mathematics do you think your children will need to know in their future lives?	2	Trying to identify underlying beliefs about mathematics.
What do you think are important aspects of mathematics?	2	Trying to identify underlying beliefs about mathematics.
What have you tried which is different to your normal way of working?	1	Looking for success, reflection and development.
How would you like to work with these children in mathematics?	2	Trying to identify underlying beliefs about mathematics teaching.
What do you feel you need to know about?	4, 3	Attempting to identify constraints on pedagogical practice.

Teacher and researcher journals

The use of reflection diaries or journals as a research tool, especially in educational settings, has become more popular in recent years (Hogan, 1998). Associated with this is the use of narrative and storying as methods to elicit teachers’ thoughts and beliefs about situations in their classroom life (Chapman, 1993; Clandinin, 1989; Clandinin & Connelly, 1996; Connelly & Clandinin, 1990; Johnston, 1994a).

Beginning teacher journals were an attempt to provide data from the time between researcher visits. Aspects of the journal fed into the interviews and acted as catalysts to talk and reflection by the beginning teacher. The essential reason for writing in the form of a journal or diary was to remember the experience and try to understand it (Hogan, 1998). This was another attempt to bring to the surface beliefs held by the beginning

teacher. Practices in the classroom were then more obviously compared to thoughts and beliefs and any mismatches noted and discussed. Often the associated tensions which arise from a rereading or review can be a powerful force for change, both to classroom practice and deeply held beliefs (Hogan, 1998). Thus, beginning teachers, on their own or with the help of a support teacher, can begin to think critically about the taken-for-granted aspects of their own practice, beliefs and schooling in general.

Narrative is a natural way for people to make sense of their lives (Johnston, 1994). It allows teachers to recall their experiences, to organise their thinking and to tap into the collective, accumulated wisdom of their profession (Jalongo & Isenberg, 1995).

Humans are storytelling organisms who, individually and socially, lead storied lives. The study of narrative, therefore, is the study of the ways humans experience the world (Connelly & Clandinin, 1990, p. 2).

So often, and for beginning teachers in particular, there is professional isolation for the teacher. They work on their own with their classes in their classrooms and rarely talk with other professionals about their work. Talk is at the margins of the day and is often snatched conversations over coffee, or in the car park, and usually not of a professional nature. When teachers do manage to talk of professional matters, it is often in a narrative or story form as this, for many, is a natural way to share issues of practice (Johnston, 1994). Reporting lessons as part of a narrative can be useful in illuminating teachers' professional thinking and their relationship to their professional environment. Lessons can be viewed as a collection of narrative segments (Connelly & Clandinin, 1990). What is difficult to achieve is what Mason (1994) called the 'discipline of noticing'. This is the ability to engage in uncritical observation. The use of story, as part of a journal entry, can be used to relate something that happened in the classroom. It is hard, however, to give only that—'an account' of the incident, before beginning to 'account for' it (Mason, 1994). This study used the idea of narrative in two ways, one as part of the interview schedule and the second as a component of the beginning teacher's journal entries. Narrative as a social practice is able to connect abstractions and thinking, feeling and knowing with images of action (Hogan, 1997). This connection was most important in the project, particularly in the attempt to have the teachers relate to feelings and beliefs.

Related to the idea of narrative, as part of their journal entries and interviews with the researcher, beginning teachers were asked to tell anecdotes or ‘brief-but-vivid’ descriptions (Mason, 1994) of their practice. This provided data for comparison and reflection in discussion. This anecdotal notion is similar in style to the idea of ‘critical incidents’ (Tripp, 1993) and the researcher used both nomenclatures when establishing the basis for journal entries, and as questions in the interview situation.

In this way, the project gained data relating to Research Questions One, Two and Three.

## Classroom observation

It was noted in Chapter Two, that teachers often espoused one belief about mathematics teaching and learning, but their actual classroom practice was different and sometimes in conflict with their stated belief (Clarke, 1994; Thompson, 1992). Data from the observations was used as a catalyst for reflection, as part of the interview schedule. To keep in line with the support teacher role and to try to remove the beginning teachers’ previous experience of someone observing their teaching (for example, their university supervising tutor), the researcher adopted a ‘discipline of noticing’ (Mason, 1994). This technique required only observations and incidents to be noted. There was no evaluative comment or reason for the decision offered (Ainley, 1996; Clarke, 1994).

## Case methods meeting transcripts

Case methods, as described in Chapter Three, are being used more often in educational settings nowadays (Barnett, 1992; Barnett & Tyson, 1995; Bullough & Baughmann, 1993; Louden & Wallace, 1996; Shulman, 1998). Part of the process of becoming a teacher is to be a member of a ‘community of learners’ (Adler, 1996; Lave & Wenger, 1991) and to break out from the isolation of the classroom. The notion of learning through participation in communities of practice—the social practice theory of Lave and Wenger—appropriately and powerfully illuminates learning and knowledge about teaching (Adler, 1996). This knowledge about teaching is fundamentally tied to the context of teaching and cannot be abstracted out (Burk & Fry, 1997). Discussions by members of the research group in their case methods meetings were audio taped and

transcribed. One of the strengths of case method meetings is that they expose the beginning teacher to other perspectives on a situation and present opportunities for reflection on and justification of beliefs. Vignettes for discussions came from Barnett, Goldenstein and Jackson (1994), Louden and Wallace, (1996) and NCTM (1989). Groups of teachers have tried these stories but there is no reported use by beginning teachers. Techniques used and refined by Barnett and her team used during these trials formed the basis of this investigation.

### Repertory grid

Repertory grid technique is part of the Personal Construct Psychology of Kelly (1955), a constructivist theory, and has been in use for a number of years but more recently in the work of Fetherstonhaugh (1994, 1995) and Malone (1996). Personal Construct theory proposed to identify the underlying ideas and beliefs a person has about a thing or situation. It suggested that constructs are personal tools that allow discrimination and organisation of events and allow the anticipation of future events. The project discussed here used the technique to identify the personal constructs held by the beginning teachers about mathematics. The grid used Shulman’s (1986) theoretical model of domains of teachers’ professional knowledge to develop the knowledge and beliefs component and to act as baseline data for each project participant. A Repertory grid is part of the domain of qualitative research techniques in the sense that it allows each participant to express meanings of the perceived world. A second round of the Repertory grid technique was used at the end of the year to establish any change in belief and provide data for Research Questions One and Two.

The technique used in this project followed the structure established by Kelly (1955) and refined by Fetherstonhaugh (1994) in relation to scientific concepts. Individually, beginning teachers were presented with the grids as shown in Figure 4.2 and Figure 4.3. The first grid referred to elements of mathematics content to identify constructs of teacher beliefs about mathematics, while the second concerned constructs of mathematics teaching. In each case the participant was asked to select three of the elements and say how two of them were similar but different from the third. This word or construct was

**Figure 4.2 : Repertory Grid for beliefs about mathematics**

[illegible]

Figure 4.3 : Repertory Grid for beliefs about mathematics teaching

Mixed ability	Planning	Materials	Motivating	L. Primary	Text books	Games	Mental	Calculators	Talking	Syllabus	Assessing	U. Primary	Outcome statements	Computers
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Questionnaire

Qualitative techniques are excellent for an in-depth study of attitudes and beliefs, but they are resource intensive. To collect base line data for a large sample (the complete student cohort) a quantitative technique was more appropriate. Much of the recent work in the area of teacher belief has used questionnaires as a main data source (Fennema & Sherman, 1976; Nisbit, 1991; Relich & Way, 1992, 1994; Relich, Way & Martin, 1995). As the data required for this project was from a large population (the complete cohort of primary Graduate Diploma students, approximately 60 people), a questionnaire (Figure 4.4) was more appropriate. Data from the questionnaire, given before the students left the university, provided information relating to beliefs about mathematics and mathematics teaching held by the peer group of the project participants. From this database the responses of the four beginning teacher participants were extracted. The questionnaire was given to the cohort before the names of the five case study participants were known. A repeat of the questionnaire, with only the case study members, at the end of the first year of teaching was given. This was used to illuminate any changes that had occurred.

This questionnaire provided data relevant to Research Questions One and Two. The methodology and analysis of the questionnaire had been developed and refined by Relich and Way (1994), and thus, provided a reliable instrument to identify beliefs held by a large sample of students. In the case of the five participants, a straightforward comparison of answer responses between the first and after the beginning year questionnaire was used to offer any examples of change in beliefs that had occurred, for example, a first answer of 2 was compared with the second survey response of 4.



**Figure 4.4 : Beliefs questionnaire (After Relich & Way, 1994)**

Please write in  
the scale number

—

1.

Generally, I feel secure about the idea of teaching mathematics.

—

2.

I find many mathematical problems interesting and challenging.

—

3.

Mathematics makes me feel inadequate.

—

4.

I'm not the type of person who could teach mathematics well.

—

5.

I have always done well in mathematics classes.

—

6.

I do not enjoy having to teach mathematics.

—

7.

I am quite good at mathematics.

—

8.

I have generally done better in mathematics courses than other courses.

—

9.

I'm not sure what to do when teaching mathematics.

—

10.

Time passes quickly when I'm teaching mathematics on teaching practice.

—

11.

I have hesitated to take courses that involve mathematics.

—

12.

I would get a sinking feeling if I came across a hard problem while teaching mathematics on teaching practice.

—

13.

Teaching mathematics does not scare me at all.

—

14.

At school, my friends always came to me for help in mathematics.

—

15.

I am confident about the methods of teaching mathematics.

—

16.

I have trouble understanding anything that is based upon mathematics.

—

17.

It would not bother me to teach a lot of mathematics at school.

—

18.

I never do well on tests that require mathematical reasoning.

—

19.

Of all the subjects, mathematics is the one I worry about most in teaching.

—

20.

If I taught in a team or with a teaching partner, I'd like to have another teacher to teach mathematics in the class.

## RADIATE categories

A further technique for establishing the images of a mathematics teacher and teaching held by pre-service teachers was developed by Cooney and Wilson (Cooney, 1996). Beginning teachers from the case study sample were asked to select from a list of types of people, for example, newscaster, engineer, conductor, coach, entertainer etc., which would best fit their idea of being a mathematics teacher. The important aspect of this technique was not the actual choice but the rationale for the selection. In an effort to cross validate data from other sources and provide data for Research Question Two, the project used the Cooney and Wilson method at the end of the teaching year. The use of this technique probed the use of metaphor in describing beliefs. Metaphor is also contained within the narrative approach (Connelly & Clandinin, 1990) as a way to understand the belief system of teachers.

## Characterisation scales

A data gathering technique, employed by Raymond, to establish beginning teacher beliefs about mathematics used three categories of heading (Raymond, 1997). This study also used Raymond's technique. Here the beginning teachers were asked to respond to polarised descriptors, taken from Raymond's categorisation of traditional to non-traditional approaches to mathematics, by placing a cross on an unscaled line between the two poles (Figure 4.5). Reasons for the placement were established by interview.

Figure 4.5 : Characterisation scales (After Raymond, 1997)

Mathematics is:—

Dynamic

Fixed

Predictable

Surprising

Absolute

Relative

Doubtful

Certain

Applicable

Aesthetic

Place an X to show your choice

Learning mathematics requires mostly:—

Practice

Insight

Independent work

Group work

Good teachers

Strong students

Trying hard

Being good at maths

Memorising

Understanding

Place an X to show your choice

Good mathematics teaching entails, or depends on:—

A good textbook

Use of manipulatives

Teacher direction

Student participation

Teacher effort

Student effort

Explicit planning

Flexible lessons

Helping students

Helping students

to like mathematics

to see mathematics as useful

Place an X to show your choice

These techniques were added to the data collection techniques in order to obtain aspects of triangulation of data. Comparisons were made to ascertain if the beginning teachers were consistent.

## Other data sources

Two other sources of data were established with a view to confirming the actual beliefs in practice of the beginning teacher and to see how their practice had developed over the first year of teaching. These techniques were to collect copies of the teachers’ plans for mathematics teaching for each term and to have the children in the beginning teachers’ classes offer their thoughts about good mathematics teaching. The children wrote about their ideal teacher of mathematics at the start and finish of the beginning year. The responses were compared for differences in their perceptions.

## Issues of reliability and validity

One of the issues often held against qualitative research is the possible difficulty with validity and reliability of methods and results. In this study, procedures have been established to attend to the issue of reliability and validity. Herrington (1997) offered a compilation of procedures (Table 4.5) from the literature on qualitative research methods that help to ensure the appropriateness and consistency of data collecting procedures and interpretation.

**Table 4.5 : Procedures to ensure validity in qualitative research (After Herrington, 1997)**

<i>Procedure</i>	<i>Implementation in this study</i>
Use of structural corroboration or triangulation by the use of multiple sources of data (Eisner, 1991; Miles & Huberman, 1994).	Corroboration by data source, times (throughout the year), and by method (observation, interview, transcription from meeting).
Collection of referential materials e.g., documents, recordings, against which findings can be tested (Eisner, 1991; Guba, 1981).	Use of meeting transcripts, lesson observation notes, teacher planning documents, repertory grids and characterisation scales.
Consensual validation, or agreement among other researchers that the description and interpretation of the data are right (Eisner, 1991; Guba, 1981).	Reviewed by external colleagues with experience in research methods.
Checking for research effects (Miles & Huberman, 1994).	Low profile adopted by researcher. A supervisory or assessment orientation not adopted. Opinions not offered. See later comments on limitations of the research.
Obtaining confirmatory feedback from the participants (Guba, 1981; Miles & Huberman, 1994).	Variety of data sources probed the same underlying beliefs. Participants asked during interviews if this is what they said or believed.

It must be stated, however, that the primary value of qualitative research, lies not in the verification and generalisation of universal truths, but in the rich description and thoughtful explanation of complex processes, relationships and environmental influences (Burk & Fry, 1997, p. 647). Qualitative study methods mediate against replication of results, in that, even an identical study would yield potentially useful cumulative findings (Schofield, 1990). The results would be useful but different.

## **Ethical considerations**

All research projects require approval of the University's Ethics Committee if they are using animal or human subjects. In order that this study was undertaken in a fair and ethical manner the following issues were addressed and subjected to scrutiny by the Research Ethics Committee of Edith Cowan University.

### **Informed consent**

All participants were told of the nature of the research, their commitments in terms of time, visits and any extra work that the project might entail, and the probable outcomes. Exact details were not given regarding times and dates as these were negotiated as necessary, and the amount of time involved would vary, as the participant identified particular needs. General outlines were known, which gave a maximum and minimum involvement.

A copy of a letter (Appendix 1) setting out the general requirements of the study and the responsibilities of each member of the group was given to each participant. These letters were signed to show consent for involvement by the participant.

Each agreement letter contained a section that stated that participants could withdraw from the study at any time at no detriment to themselves.

Permission was gained from the Principal for the study to take place within the school premises.

## Confidentially

All participants and schools were given pseudonyms, which bore no relationship or similarity to a real identity. These pseudonyms, chosen by the participants, have been used throughout the data and the reports of the study.

Access to the data in the form of audio-tapes, transcripts, lesson plans and journals is restricted to the researcher and for a short time to a transcriber. All data is securely stored and will be retained for five years before being shredded and disposed of in an appropriate manner.

## Chapter Five

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### **Case study analysis and discussion**

#### **Introduction**

The next four chapters will provide an analysis and discussion of the first teaching year of the beginning teachers of this study. Each chapter will look in detail at one, or, in the case of Chapter 8 two, of the participants. Factors impinging on their pedagogical practice, their pedagogical beliefs and how they responded to the support model for professional development will be highlighted. Analysis of the transcripts and other data was completed with the aid of the NUD\*IST (Qualitative Solutions and Research, 1997) computer program. Factors identified from the literature as affecting the mathematics teaching of beginning teachers were used as initial nodes for analysing the data. Other factors were identified as the data were analysed and are included in this discussion.

Each case study will begin by describing the background of the participant. This will be followed by an analysis and discussion of the data related to each of the research questions in turn. Finally, Chapter 9 will discuss themes arising when one considers the cases of the participants as a whole rather than as separate individuals.

### **Case Study — Stephanie**

#### **Setting and background**

Stephanie came into teaching by what for many is a typical route. She completed Year 12 in school, then went to a university degree, onto a teacher education course and finally, the first year of teaching. In her case, however, there was a slight deviation from the route in that she spent two years travelling and doing temporary administrative work after her university degree studies. Her initial B.A. degree studies were in psychology and philosophy. Before her degree work, she studied specialisms

Her initial teacher education course was an intensive, one-year, Graduate Diploma in Primary Education. Experience in the school setting consisted of three periods of distributed practice of one day a week, followed by a block of time with the same class. Over the year of her graduate diploma course, she completed teaching practice as follows:

- A two week block of experience with a Year 1 class;
- A two week block with a Year 6/7 class; and
- Half a term with a Year 4 class (Assistant Teacher Programme).

Stephanie graduated from her teacher education course with a competent mark for her final Assistant Teacher Programme (ATP) indicating an above average mark and a high level of skill for a beginning teacher.

Stephanie was one of a small number of graduates from the Primary Diploma programme to be offered a position with the Education Department of Western Australia (EDWA). She was, however, one of only two to be assigned to a school in the Perth Metropolitan area, albeit at the extreme edge of the district. Fellow graduates from the course, either didn't wish to proceed into teaching, were not allocated a position or more typically were given positions in some of the country and remote schools of Western Australia. At this time, EDWA was very selective of candidates for teaching positions. As Stephanie was offered a place, it indicates that she was regarded as potentially a very good teacher. She received notification of her appointment to the Department and a school only a few weeks before the start of the first term.

Initially, she was assigned to another primary school in the same sub-district—a large satellite town near Perth. During the first week of Term One, however, she was relocated to her present school. Here she started as the full-time teacher of a mixed grade Year Five and Year Six class of 31 children. She shared part of her teaching load with two colleagues Mrs. J., who taught the Year Six children twice a week for measurement aspects of mathematics, and Ms. B., who was the art specialist. In the first semester Mrs. J. taught the whole class Social Studies and Science. This changed to Social Studies and Physical Education in the second semester. Other support came from a teacher who taught three lots of writing during the week. At this time,



teacher-aide supplemented the teaching in the Third and Fourth Term. Mrs. J. taught the class for the first week before Stephanie took charge. Thus, there was no time for Stephanie to undertake initial planning for the class or to learn about the school. She had just a one-day visit to the school before commencing. This was not a normal procedure, but such things occurred at this time of the year as EDWA rationalised class size, school population and teacher availability. As a result of this Stephanie was already at a disadvantage.

The school was built of brick with its own grounds and sports field. An H-shape in design, it has classrooms adjoining long corridors and passageways, typical of the Nineteen-Fifty era. It has a full time teaching staff of a Principal plus five teachers. To this core were added six specialist and part time members of staff. There were approximately 160 children spread over five classes.

The thirty-one children were housed in a large, closed classroom and usually sat in groups of five or six. The classroom had a high ceiling, and large windows overlooking a central, hard-play area. While there was a relatively high transient population in the area, this had only a minor effect on the class, with only two or three children moving. Some children did join the class for a week or two before relocating.

Stephanie suggested that the children in the class were typical of the area. The variation of ability of the children within each year group was enlarged by the joining of Year Five and Year Six children into the same class cohort. The school served the immediate area, which Stephanie described as “low socio-economic and transient”. There was high absenteeism and quite a lot of movement to and from the area. The attitude of some parents was to see the school and education as not being essential. Children often came from homes with family configurations other than the norm. Stephanie gave this opinion of her class in the first term. It shows a stereotypical view of the class.

Stephanie described the children in her class as “kids who have grown up fast”, in the sense that they have probably been exposed to a lot of things atypical of children of their age. They were not used to having boundaries set and often found this a difficulty. But on the other hand, she noted, many of the children liked having a

structure and did not cope well if the way of doing things was not obvious or was changed without warning.

Stephanie had a strong background in mathematics having studied mathematics to Year 12, and having undertaken statistics and calculus courses as part of her degree at university. She was confident as a mathematician and had a positive self-image of herself about doing mathematics. Her responses to the initial beliefs questionnaire showed her to believe that she had done well at mathematics, and that she found mathematical problems interesting and challenging.

The next section will consider factors influencing Stephanie's teaching of mathematics in her Year Five and Six class.

### **Research Question 1**

*To what extent do the following factors influence the pedagogical practices of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's behaviour and reactions;
- the beginning teacher's own education;
- the beginning teacher's beliefs about mathematics, mathematics teaching and learning;
- professional development;
- the researcher; and
- other sources.

One of the main aims of this study is to identify and describe factors that influence classroom practices of beginning teachers. This section will outline factors identified in the case of Stephanie. Evidence will be offered from the 'snapshots' of her first year of teaching to support those factors noted in the literature and others that are

particular to her situation. Each factor identified will be discussed. They will be related to findings from the literature on beginning teachers and beginning teachers of mathematics, to provide a clearer picture of the classroom influences. Where evidence is offered from interview transcripts a coding related to the order of interview is inserted, for example ST7 refers to the seventh interview with Stephanie. A complete timetable of interviews is given in Appendix 1. After the first reference to Stephanie, S will indicate her in the transcript. In a similar fashion, L will indicate Len. The factors are discussed in a tentative order of importance as reported by Stephanie. While these factors will be discussed separately for convenience, it should be realised that the experience of a beginning teacher is not so simple and actually consists of a myriad of connections and overlaps of these factors. This aspect will be discussed in more detail later in this section. Factors here are discussed in terms of their importance of influence on Stephanie's pedagogical practice. In some instances there was no evidence in the data to a particular factor. In that case it will not feature in the discussion related to the particular case study. This will be the style of presentation adopted in all case studies reported in this study.

### Time constraints

For Stephanie this was a major issue. She talked of time and time related factors throughout the year. In general terms she talked about the lack of enough time to do the things she felt she had to do. One might suggest, with the benefit of hindsight, that even with more time available, some of the problems she discussed related to issues of time would not be overcome.

From the start of the year, Stephanie was under time pressures. Because of her particular circumstances, she had started at the school a week into the first teaching term. She had been transferred from another school in the area when their staffing allocation had been finalised on Day One of the teaching term. She had not had, therefore, the time to become familiar with the school, its setting, the resources and support available and the staff. She had little or no knowledge of the children when she met them on the first occasion, as she was not able to access their records or discuss them with the previous year's teacher. There was also little time in which to prepare work and develop an overall teaching plan for the term. Thus, throughout the

normally have been done before the first term started. At a time of survival (Veenman, 1984) and anxiety, she had extra pressures placed on her. Another teacher, who began to establish classroom routines and organisational procedures, took the first week of the teaching term. Stephanie changed many of these procedures during the subsequent weeks, as they did not suit her style of working. Already, she had to work with factors beyond her control, which are untypical of a teacher starting with a new class.

Stephanie also noted one factor related to time, identified with experienced teachers by Sparrow and McIntosh (1998). This happened throughout the year, namely her need to cover the syllabus content and the lack of enough time to complete the task with her class. For Stephanie this was a large issue and one that determined much of what she taught and how she taught it.

Stephanie:...but also if you are looking at the syllabus and thinking how much of the syllabus I've still got to get through by the end of the year (ST7).

Thus, syllabus coverage became the driving force behind her teaching. To a certain extent, it took precedence over most considerations related to teaching. The aim, and this recurred throughout the year, was to make sure, possibly at all costs, that every check box on the mathematics syllabus overview for Year Five and Year Six was ticked by the end of the year.

This determination to 'do' everything had a number of consequences related to her classroom teaching and expectations of children in the early part of her first year of teaching. For example, if something was not written on the syllabus checklist it would not be included in the teaching programme. This was particularly the case in the first three terms but did change slightly in Term Four. An example of this phenomenon was with a Working Mathematically style of teaching (EDWA, 1996) which involved an enquiry and investigative work by children. She knew about this from the Student Outcome Statements. It was not, however, a section on the mathematics syllabus, though it is underpinned with such a philosophy in many cases. Stephanie saw it as an extra to her main goal of syllabus coverage. Consequently, she did not attempt to work in this teaching style with the children.

Len: And there's no Working Mathematically in the syllabus?

Stephanie: There's not. No. There's a bit of time pressure to get through (ST4).

The recent curriculum documents from around the world, for example, from the National Council of Teachers of Mathematics in the United States of America, the National Statement and Student Outcome Statements in Western Australia and the National Curriculum of England and Wales, and her teacher education course, all have an emphasis on problem solving and working mathematically in general. For Stephanie, while she was aware of this emphasis and had an initial understanding of the term, the syllabus coverage took precedence and largely determined what she did. As a consequence of this headlong rush for coverage, the syllabus and time factors inadvertently also played a part in how she taught, as well as what she taught.

Aspects of pedagogy that involved children using materials or working in a more open way were not generally used because they took more time.

S: You usually need a good [amount of] time doing that sort of hands on thing...(ST8).

S: And maybe to not having time to go hunting or finding bits and pieces (ST9).

Similar comments were given when talking about practical activities, and tasks where children discussed ideas, investigated situations or solved problems. These, in Stephanie's mind, took much longer to do and were more difficult to assess. Consequently, she usually substituted a teacher directed approach, as it was quicker to cover the content by telling the children what to do. Issues of assessment and the integration rather than separation of ideas and techniques will be discussed in more detail later in this chapter.

Throughout the year Stephanie was constantly faced with a dilemma of balancing the speed of coverage of the syllabus with the slower approach needed to help children learn and understand.

L: So there's this dilemma all the time isn't there, whether you should get through everything or go slow enough to make sure kids understand it (ST7).

Stephanie was aware of the situation and how the speed necessary for coverage of the syllabus content actually meant that the quality of learning for many children was shallow and tenuous. This dilemma was more clearly voiced as the year progressed and Stephanie became aware of the need to achieve some form of equilibrium between the two.

L: So let me be unkind and take this sort of reflection that in order to placate the next teacher or to be able to say that you've 'done it', that you are a good teacher, you're going to rush through it.

S: So at least cover a bit of everything, it might not get covered in huge detail, but try and find a bit to make it a building block for the next bit and at least that bit's covered and you make a foundation.

L: But you've just said to me that with the kids you've got now, they really didn't have the foundation of place value (ST7).

The consequences of the coverage 'at-all-costs' style of teaching were to be seen in the classroom, as many of the children "hadn't quite got the place value"(ST4). Stephanie noted she was forced to 'back track' before she, and they, could move forward to her syllabus starting point. This delay and extra time taken added to the time pressure she felt to cover everything for the next teacher, and to be seen as a 'good teacher'.

Not all children in the class needed to be 'taken back,' as they already understood the idea and could have coped with the work. Generally, however, they were forced to complete the same work as everyone else because "I have not had time to organise something different for them" (ST5). Issues related to mixed ability teaching and differentiation, a factor influencing her practice, will be discussed later in this chapter.

Associated with the issue of children not understanding the pre-requisite knowledge for the activity, and thus, having to go back “three steps,” was the fact that the class generally took longer than expected by Stephanie to complete tasks and thus, added to the time pressures.

S: Week five and six were congruence of shapes which is fairly constricting and [I] found everything took longer than I thought it was going to do and everything got crammed in or got shuffled out... (ST7).

A possible consequence of the pressure to cover the syllabus in the time allowed, is for the emphasis to be placed on the teacher teaching rather than the children learning, that is learning in any depth. Skemp (1976) discussed the notion of *instrumental* and *relational understanding*—the coverage model being pursued by Stephanie would lead generally to shallow *instrumental* learning, rather than the more favoured *relational* understanding.

Another consequence of time pressure was an undifferentiated approach to teaching which had all children doing the same task at the same time and being expected to reach the same learning outcomes. Children that were more able were not set tasks to meet their needs. Stephanie thought this might encroach on the syllabus content of the next teacher. It would take in addition, more time to prepare and was beyond the pedagogical ability of Stephanie at that stage of her career.

The complexity and interrelatedness, as noted earlier, of the factors were already evident. Lack of enough time was the main issue, but it was closely connected with the nature of the knowledge of the children, the amount of work needing to be taught, as outlined in the syllabus, and the perception of what constituted a good teacher. Change was slow “probably due to the lack of time to really sort out... just time to sit and think and think how can I do it in a better way” (ST7). For Stephanie and for many experienced teachers :

S: There is so much time just getting through day-to-day and ... [to] do in the day that you don't have time to really sort of plot and think a lot about what you are doing (ST7).

While lack of time was a major influence on how Stephanie taught, especially in the first three terms of her first year, she was also influenced by the context in which she had to teach. The influence of the school context, in the form of colleagues, has already been alluded to in the pressure Stephanie felt to cover all the syllabus material ready for the next teacher. This, and other factors associated with the school context, will be discussed next in this section.

## **The present school context**

Factors from the school context may be grouped, for convenience of writing, under these three headings— colleagues, materials and children. Institutional tradition, as noted by Mousley and Clements (1990), appeared to be a major influence upon what happened in classrooms in a school. The debate in the literature on the influence of a particular context on teacher behaviour was discussed in Chapter Two. The debate centred, however, on teachers in general, while the next section will consider the influence of such factors on the pedagogical practice of a particular beginning teacher.

### **Colleagues**

The connection between colleagues, the syllabus and what is taught has been discussed in the previous section. Briefly, the content of what Stephanie taught was governed by her perception that her colleagues would expect her to ‘cover’ the mathematics work outlined in the syllabus for her year. She would not ‘move the children on’ into the next teacher’s syllabus content section, even if she knew they were conceptually capable of understanding and benefiting from such work.

It appeared that Stephanie ‘knew’ what was expected of her by colleagues but these expectations had not been discussed or outlined, in any explicit way. There were no school ways of doing things, policies or guidelines for what must happen in mathematics.

L: What about ways of doing things in the school? How did you ever find out about what they were, or are there specific ways?



S: ... not really no. It's sort of an approach of as long as you're happy with what you are doing and you find it's working, then there's no pressure to do it ... or do things the same way (ST3).

While there were no "strict guidelines of how you have to do it" (ST3), it appeared from Stephanie's actions that there were unwritten ways to teach mathematics, that everyone knew, and were assumed by the members of the school community. The social heritage (Mousley & Clements, 1990) of teaching was exerting an influence. Stephanie was aware of what was expected of her to be judged as a good teacher of mathematics. This awareness had possibly come from her time as a child in mathematics classrooms.

The teacher who worked with Stephanie's class for the first week did 'speed maths sheets' which Stephanie continued. These sheets were generally completed once or twice a week and involved the children completing sets of recall questions within a time limit. The goal was to have all questions correct in an ever-decreasing time. Such a style of work would generally fall under a category of traditional approaches to teaching. Stephanie copied this style of teaching. As she was new to the school, she tried to fit in and to become a member of the group by copying a model of teaching she had seen being used by a member of that group.

Assumptions about the acceptable level of noise in the classroom were also important. One of the constraining factors in implementing discussion-based work, or having children working in more open and problem solving ways, was the expectation that mathematics is done silently on your own. A traditional classroom teaching style for mathematics, and possibly an unwritten assumption within the school, was that a good class would be a quiet class. Problem solving often requires children to discuss their ideas and work. Thus, Stephanie was presented with a dilemma. Should she do problem solving with the children and run the risk of children chattering, and be seen by colleagues as a poor teacher, or should she play safe and adopt traditional classroom approaches with less risk of misbehaviour and noise?

S: In other areas, yeah, it [children discussing] shouldn't be too hard. But talking in maths is harder because it's "shush be quiet".

L: By you or by everyone?

S: By everyone. I do it as well but ... (ST4).

The Principal did not ask to see any of Stephanie's planning—a local teacher union agreement does not permit this too happen. Stephanie, however, felt that he was aware of what she was doing. The spectre of assessment and approval was still there because, as a beginning teacher, she was subject to two performance appraisals by the Principal throughout the year. She also felt that he might ask, at any time, what she was doing and how things were going. For her, the perception was that she ought to be 'doing the right thing' in mathematics. The right thing, she felt, in this school, was to work in a traditional way.

The school had a mathematics room and a mathematics specialist but no mention was made of any explicit contact from this person, although she taught the Year Six children from Stephanie's class for aspects of mathematics each week. Stephanie mentions informal conversations with other teachers and listening to them talk, as ways in which she found out about the teaching of mathematics within the school. As she moved around the school she was continually 'seeing the results of their teaching', for example, she saw material being prepared for the children in the form of black-line master sheets, books and children's mathematics pads in the staffroom. Thus, she was influenced in more subtle and informal ways.

### **Materials**

Along with the mathematics room and the mathematics specialist, the school had a range of mathematics equipment and resource books. However, their influence on Stephanie's pedagogy was limited. Firstly, there was only a small amount of each sort of equipment and as Stephanie was mainly working with the whole class there was insufficient material for all the children to use. Rather than change her teaching style, to incorporate the material, she avoided using apparatus to support the children's thinking and learning.

L: Let me think, let's see, things like Polydrons, geo-shapes...

S: We have got some of those which click together. But we don't actually use them (ST7).

It was quite interesting to note the use of 'we' in this context. Does the 'we' refer to the school community? Was the social context also exerting an influence here on how mathematics should be taught and what should be used in that teaching?

Time factors and control issues were also influences on her use of materials. There was not enough time for her to get materials from the mathematics room. Activities using mathematical apparatus usually took longer to complete and there was a much greater chance that the children would become excited and become a control problem. The issue of 'time' was discussed earlier in this chapter.

Stephanie commented that there were mathematics textbooks around the school and that she had some of them and used them with her children. There was not, however, a set textbook that had to be used by each class. The books, which Stephanie consulted were the usual ones found in schools in Western Australia, namely *West Australian Mathematics* (WAM) and *Mathematics Today Series* (MTS). Both are closely aligned to the Western Australian Mathematics Syllabus, which Stephanie found supportive in planning and programming. The books influenced *how* she did things and, as Sparrow and Swan (1997) noted in relation to this factor, *what* she did. The books adopt a traditional teaching style. They contain only minimal reference to such things as working mathematically, problem solving, discussion-based teaching, the use of calculators and the development of mental strategies with children. Thus, as these ways of working and aspects of wider content did not appear in the textbooks, Stephanie was again influenced and did not adopt this style of work or use this aspect of mathematical content for her class. She stayed with a traditional approach as dictated by the textbooks. Textbooks, therefore, became another factor influencing her pedagogical practice.

### **Children's behaviour and reactions**

Another major influence on the pedagogical practice of teachers identified in the literature (Kagan, 1992; Kennedy, 1997; Nickson, 1992; Rosenberg, Griffin, Kilgore

& Carpenter, 1997) was the children's involvement and interaction with the teacher and especially the beginning teacher. With Stephanie, it appeared that the children were a factor in what she did in the classroom. As one considered the data, however, it was apparent that on some occasions Stephanie's pedagogical practice was influenced not by actualities, that is what children did. The influence was her perception of what they might do, if she was to dare to do anything out of the ordinary. Generally, she was not prepared to take the risk, especially so in the first two terms of the year. Later, however, as she became more confident in her ability to 'handle the kids', she did offer activities and tasks of a less traditional nature.

The speed at which she was able to work with the children changed from her initial thoughts and expectations. She found the children generally much slower at working than she had expected. The ability of many, but not all, of the children was lower and their understanding more unstable than she had anticipated. These two factors—slow speed of working and lack of understanding—when combined acted as a dampener to what she felt she could attempt with the children, especially early in her first year of teaching.

Stephanie tended to use what the children could not do as a justification for her teaching style. Possibly, this also confirmed her traditional philosophy of teaching mathematics. These two aspects, the lack of ability of the children and her underlying belief, combined to offer an argument that could be used to show that it was impossible for her to teach in any other way. She was aware that the children were different but chose to ignore this in order to reduce the problem management. All children were assumed to have the same abilities and deficiencies, that is, they were all equally "unsure of place value strategies". Thus, they were all taught in the same way at the same time.

S: But, yeah, the practicalities come in and you can't always have something else for the other kids to do, and you don't want to get them too far ahead on the next thing you are doing because you're going to get them even further in front (ST7).

The limited ability of the children was a factor Stephanie noted as a reason to be structured in her teaching style.

S: They still need quite a lot of structure. They don't like it if they are not sure of exactly what they are supposed to be doing, in a certain sense how to do something (ST7).

She seemed to be saying that children have an image of mathematics as a set of rules and procedures and that the teacher's job is to show them the method. All they, the children, have to do is to learn to do it in the same way. If Stephanie moved out of this teaching style, she perceived that the children would be uncomfortable and possibly present a control problem for her.

She does, however, report wanting to do an activity requiring a little more thinking on the part of the children in Term Three.

S: ...I see them like exploring off on their own...not as a group ... on the whole they lean more towards what they've been shown how to do or working out how to do something and then saying is this the right way. So maybe sort of setting up the task and letting them have a go at it on their own for a bit and then bringing them back and looking at what they've found and saying, 'Here's a way we can do it', for the one's who didn't pick up their own way, they've actually got something they can still do (ST7).

There remains the image, given by Stephanie, that mathematics has a right way and that it is important for children to know that way. The children appeared to be the factor used by Stephanie to justify remaining in a teacher-directed mode of teaching. A second strong feeling, which influenced her pedagogical practice, was that, even if she did allow for a bit of thinking by the children in her lesson planning, it was still vital that children know the right way to do something. She was still influenced by a traditional view of mathematics as a set of rules and procedures to be learned.

Stephanie noted that the children tended not to work well other than on their own. Stephanie also had concerns about the group dynamics with children being left out and others not taking part in the activity and having a 'free ride'. Another factor that possibly interacted here was Stephanie's lack of experience in organising and managing group learning, as well as her lack of pedagogical knowledge relating to her role within this style of teaching. Part of the discussions at this time involved

reflecting on a range of options that might be employed to help children work in group situations and so derive some learning from them.

Working in ways which required children to write or report orally, things that had happened and what they had done or found, were curtailed. This was because Stephanie felt that, as well as such procedures taking longer to complete, the children did not have the necessary skills to undertake them.

S: ...it takes them so long to work out how to put a sentence together that they haven't got time to go into great detail about what they did (ST4).

S: ...it takes so long, they can't sort of think and scribble it down, it takes so long to actually convert what they're thinking into writing on a page, they've just lost that train of thought (ST4).

S: They're certainly not used to explaining how to do it (ST4).

These comments, and those related to the children's inability to work easily in groups, mainly because it was a completely new way to work and beyond their experience, one could argue were used to show how it is not possible or desirable to work in that way. The idea of actually teaching children how to work in groups and how to describe what they have done or found is not considered, at this time, as a possible way forward. Time and coverage issues took precedence.

Later in her beginning year when control was less of an issue, and as Stephanie became "confident enough with the kids...to think [she] could manage them in that sort of situation" (ST8), she began to offer some less tightly structured activities. There are still constraints being imposed by some of the children or felt by Stephanie, which made her keep some of the activities in control of the teacher. These teacher-directed activities accounted for the 'home background' of the children. Stephanie described them as

"kids that have grown up fast. They are kids that see... probably exposed to a lot of things which other kids at their age are not really exposed to ... (ST8).

The structure within the activities was her response to her growing knowledge of the children.

S: They're a little bit more challenging. They are not always used to having boundaries set, they're not used to having boundaries all the time... and they find boundaries hard to cope with, but on the other hand... they like having a structure. They don't cope at all well if you change something without warning them first... it causes chaos. They like having structure but they don't like having boundaries...(ST8).

Stephanie appeared to use the word boundaries to mean the procedure that the children had to follow so that they could complete the task to her satisfaction. In some cases, however, they did not like being told what to do and being restricted in their freedom.

By Term Four Stephanie was thinking about the needs of the children in relation to her teaching. She had probably known much of this for quite a while. Only now had she the confidence to try a different style of activity to try to accommodate children's learning preferences.

S: They don't like to admit that they've been told what to do but they, some, actually want to know what to do.

L: So I guess that sort of thing would come out in the sort of teaching style you adopt?

S: Yeah! You try and get them to work out for themselves what to do ... giving them guidelines to work in but not saying here's how you do it. Here's what you have to get done ... here are the boundaries ... here are some guidelines.

L: Generally how do the kids respond to that?

S: Two groups in the class yes, maybe half to a third who respond to that and go off and do it and then maybe another ... well probably two-thirds who do that and then a small group who want

to know what we have to do and want it step-by-step ... but on the whole they do quite well (ST8).

For Stephanie the fear of loss of control of the children provided her with the reason for staying with a teacher-directed style of teaching. As she became aware of their actual abilities and adjusted to their speed of work she was able to release some of the structure in the lessons. The growth in confidence in her ability to manage the children also allowed her to change her teaching style.

### **Control of the children's behaviour**

One of the major factors associated with children and beginning teachers' pedagogical practise is that of control. During the period of survival (Veenman, 1984), this is a concern for most beginning teachers. For Stephanie this was an issue but only in the last meeting, towards the end of Term Four, was it raised in an explicit way.

S: I think just for the sake of wanting to have the kids under control and quiet and still concerned with having them in their seats and working quietly, partly that and partly not knowing what there was around to use probably... mostly wanting to keep them under control (ST9).

Before that time, the control factor was always there and, in fact, dictated much of what Stephanie tried or was prepared to try. Teaching styles that were away from a traditional approach, even those styles a little out of the ordinary, were not attempted because there might be control problems as a result of using them. Stephanie began to see the potential also of certain teaching styles being useful for controlling the children. The 'speed maths sheets', introduced by the teacher from the first week of teaching were a prime example.

S: ...the teacher who had them [the class] for the first week had a mental maths sheet and they all sort of go across and I tended, if I want them to be quiet for five minutes while I get my head together and do something and it's O.K. speed maths sheets out ... (ST8).



In the early terms of Stephanie's first year, the children were a constraining factor on her practise. Later in the year, they became a motivating factor. As she grew in confidence, and knew she could control the children, she gradually introduced other ways of working. One of the observed lessons in August showed evidence of children being asked to think and reason, work with materials, albeit in a very restricted way, and discuss problems. Generally, the children responded in positive ways and did not 'mess up', which encouraged Stephanie to try similar activities more often.

S: I've only done it once or twice, but yeah, the kids have enjoyed it and they didn't necessarily understand exactly what a percentage was, but they were using them and they were saying 100% for the whole body and...(ST8).

For Stephanie the children had an initial constraining influence on her pedagogical practice. Later, however, they acted in quite a positive way to confirm her in her moves to adopt a more child-centred approach to her teaching.

### **Assessment of the children**

The issue of assessment noted earlier in the discussion related to the time factor. Throughout the year assessment concerns recurred under other points—time issues, teaching style, mixed ability and expectations of children. There may also be a connection to a factor of pedagogical knowledge or, more likely, a lack of pedagogical knowledge, in that she may not have known of other ways to assess. This factor of lack of pedagogical knowledge will be discussed later in this section.

Stephanie adopted a summative style of assessment, mainly pencil and paper testing, at the end of a piece of teaching. This sat very neatly with a traditional style of teaching she was using. Early in her first year, Stephanie found out about what the children 'knew' this way. 'Knew' at this time meant, in many cases, can reproduce the procedure for a particular algorithm or can repeat certain facts. The traditional test was seen as easy to implement, quick—bearing in mind her time concerns noted earlier— and gave information Stephanie could use. Other forms of assessment, she suggested, gave "information in a form that you can't use or [you don't] know how to use" (ST4). Here again the complex, interrelated nature of factors influencing pedagogical practise was evident. In this case traditional pencil and paper testing was

used because of a combination of time, her own experience as a pupil, her teaching practice experience and her limited knowledge of alternative forms of assessment. For Stephanie, the traditional test was quicker to administer and gave a mark for the child, which easily transferred to her teacher's mark book and the school's reporting system. Report writing, a requirement of the school, influenced what happened in Stephanie's classroom. The format of the report required undertaking a testing programme and Stephanie interpreted testing to mean traditional pencil and paper testing.

The issue of assessment governed much of what Stephanie did with her class. Teaching style tended to be 'traditional' teacher directed and textbook or work sheet orientated because it was easier to obtain a mark and indication of what children knew. In simplistic terms, if children completed a textbook page or worksheet correctly, Stephanie assumed that they knew the material. This knowledge was confirmed, or not, when they later completed the test on the subject of a similar format.

S: I'd be stumped on where to assess it [activity] formally ... to say what they did or didn't learn ... which might also be another reason why my other lessons have not been so active because you can't assess. It comes back to the assessment thing again (ST8).

During the year, the issue of assessment was discussed a number of times. Trying to find out what children could do and what they knew was an issue discussed early in the year. As well as options offered by the researcher, Stephanie had professional development sessions as part of a school initiative with the local area mathematics consultant. These sessions were complementary to the options discussed with the researcher. Options suggested ranged from setting a task to act as the assessment focus, to children writing mathematics journals, to the use of portfolios of work. Styles of teaching which required children to talk and give oral reports of their findings were highlighted as ways to assess. The researcher lent books and examples of assessment tasks, and a CD ROM (Herrington, Sparrow, Herrington & Oliver, 1997) with over twenty-five examples of different ways to assess, with which Stephanie was familiar from her teacher education course. Generally, the options were not implemented, although they were originally accepted with enthusiasm and a

willingness to try them. The focus of professional development in the school related to the Student Outcome Statements of Western Australia. These highlighted alternative ways of working with children and assessing their mathematical understanding. This formed the basis for discussion among staff, but generally, the ideas did not translate into pedagogical practice in Stephanie's classroom. The influence of the school context, professional development and the research project suggestions, should have been strong. They all happened, however, at a time of 'survival', and were not incorporated into Stephanie's pedagogical practice as her attention and focus was elsewhere.

From discussion with Stephanie, there seemed to be two things that emerged related to assessment. There was a distinction between 'real' assessment, that is pencil and paper testing, and other sorts of assessment. There was willingness and support to try other assessment methods, as Stephanie wished to find out more about the understanding held by the students and acknowledged the shortcomings of the traditional way. During most of her first year of teaching, she found implementing them beyond her ability. The need to survive by covering the syllabus and controlling the children were over-riding factors.

### Beliefs about mathematics, mathematics teaching and learning

The main consideration in this section is to see how much influence Stephanie's beliefs actually had on her pedagogical practice. It is difficult to ascertain from the data aspects of her beliefs that were a factor in what she did, as often these beliefs were deeply ingrained and not explicitly stated. Research Question Two, which is discussed later in this chapter, considers the issues of beliefs in more detail.

Many teachers do not have an articulated connection between what they espouse as their beliefs and their actual pedagogical practice (Thompson, 1992). Thus, much of what Stephanie did may not be overtly connected to her stated beliefs about mathematics or mathematics teaching. On the other hand, other researchers have suggested that actual beliefs about mathematics teaching and learning are a major influence on pedagogical practice in the classroom (Raymond, 1997).

Stephanie's view of learning mathematics, at the start of the year, could be simply stated as a process of repetition of procedures by children. If the child did not understand the procedure at first, then further repetitions were needed until the procedure was remembered and could be reproduced.

S: ...you get the ones, cause you also get the ones that do understand it first time and they've got to then go through repetition after repetition for the ones that still haven't got it (ST7).

This transcript appeared to suggest a belief in a traditional view of mathematics teaching—transmission by the teacher of procedures and the practice by children of routines, facts and skills.

The class, generally, were taught as a whole unit, though there were times when part of the class (Year Six children) went to another teacher. All children did the same thing at the same time. Outwardly, this suggests a belief that all children of the same age need the same work and that 'teaching-to-the-middle' is the way to allow for any variation in mathematical ability. Stephanie acknowledged that she was aware of the different mathematical needs of children in the classroom and that she should prepare work more suited to these needs. The practicalities of the classroom became a constraining influence on those beliefs.

S: But yeah, the practicalities come in and you can't always have something else for the other kids to do, and you don't want them to get too far ahead on the next thing you are doing because then you're going to get them even further in front (ST7).

A belief held by many teachers is that mathematics is mainly about number and number is mainly about basic facts and the standard algorithms for the Four Rules. Added to this belief about mathematics is the notion that there should be some work on measures and something on spatial aspects. This view may be coloured by the requirements of the mathematics syllabus when actual classroom practice is considered. The emphasis for teaching is on number and facts, which seems to be related to Stephanie's belief about mathematics. The teaching related to measurement and shape and space comes not from a strong belief but from the requirement to

complete the Western Australian Syllabus document. Working Mathematically is apparently not in Stephanie's beliefs about mathematics or in the Syllabus, so it has little influence on her pedagogical practice. This again may be too simplistic a view, as the constraints of the classroom, in the form of children's behaviour, among other things, also have to be considered.

Later in the year, the emphasis in the classroom had changed from the belief that what was needed was a highly structured, teacher-dominated pedagogy, to one which was more accepting of children's thinking.

S: Yeah. You try to get them to work out for themselves what to do ...giving them guidelines to work in but not saying, "Here's how you do it" (ST8).

There is still a degree of teacher control but the reins have been loosened somewhat.

Even by the end of the first year of teaching the image of mathematics being a series of things to remember and reproduce was quite strong. Big ideas were broken down into memorable chunks for the children to learn. Mathematics was still viewed as a hierarchy of skills and facts.

S: I think taking kids through something step by step. So breaking whatever we are trying to teach down into smaller parts and doing them one at a time rather than trying to present the whole thing at once. They can't seem to cope with lots of things at the same time (ST9).

Her belief about mathematics was different from her belief about other curriculum areas, for example, language teaching.

S: I think it's [mathematics] different. It still feels like, and probably because of the way the syllabus is, it still feels like it's little pockets of information the kids are supposed to know. Whereas language ...they're picking up more skills ...it's more skills in language. There are writing skills and spelling skills and

the processes they're going through. Whereas in maths it still feels like you're teaching blocks of information (ST9).

Her belief about a mathematics teacher was one of a coach, someone to help. The following piece of transcript was part of her response to the RADIATE categories (Cooney, 1996).

S: Because the coach has, whether they're working for or working with, to be giving something, and the coach doesn't do anything for them, they're giving them advice about how to do it and watching what they're doing and saying, 'Oh, no you have not quite got that bit right', or 'it would be better if you did it with this'. So it's sort of watching and advising rather than actually doing it for them.

S: ...probably in some ways an entertainer, because you've got to make it appealing and you've got to get them to want to find out a bit more about it ...and part of the entertainer's job is to make ...get people interested and feeling part of something. But I think the maths thing would be more a coach than an entertainer (ST9).

This reinforces the belief that mathematics is a series of skills to remember and practice. The coach observes, finds areas of weakness and advises the child via scaffolding to produce an unblemished performance of the procedure. The idea of the entertainer suggests that while it is acceptable to make other subject areas interesting and fun, mathematics is serious and has little or no room for fun.

### The beginning teacher's education

The literature on teacher beliefs noted that the teacher's education, Lortie's (1975) *apprenticeship of observation*, had a strong influence on what the teacher subsequently believed about teaching and put into practice in the classroom. Does Stephanie's own education in primary and secondary school have any influence on her teaching? The data showed only minor explicit occurrences of this influence.

S: The past teachers ...I had a couple of primary school teachers who were very into sorts of things like puzzles and problems and I always liked that sort of thing so I thought that would be something to include in maths teaching. I haven't actually done it ...but I always thought it would be good to do ... (ST8).

What she remembers of her time as a child in the classroom was enjoying puzzles and problems and making mathematics fun. Her own practices in the first year puts these memories to one side because they are not easily connected to the syllabus and may take up too much time in their completion.

S: ...it's probably a case of not quite seeing at the moment where they can fit in and what they can link up with, there's too much else to get through.

S: I mean, they've got links with the curriculum but I can't quite work out whereabouts in the curriculum they are actually going to fit...(ST8).

What was not stated explicitly, however, was the influence that her previous education had on her day-to-day teaching style. She said that "probably the way I was taught is the biggest [influence] ... and making it fun ... making it not just - here's the way to do this sum"(ST7). Much of Stephanie's early teaching could be described as traditional and procedural in nature; almost the opposite of the style she wished to adopt and reported she had experienced. Procedural teaching, however, is a style adopted by many teachers and thus her own school-day experiences of teachers may be an unconscious, contributing factor to her initial pedagogy.

### Her teacher education

A theme arising from the literature was that in many cases there was little or no influence of teacher education courses on the actual practice of teachers. Somehow the knowledge from the teaching course was filtered out or seen as not relevant, or too far removed from the student teacher's experience to be connected and understood. It should also be acknowledged that the researcher had been Stephanie's mathematics education tutor on her one-year, teacher education course. Possibly she

would not mention an aspect of her belief if she felt it was in opposition to that she perceived the lecturer held.

Teacher education received almost no mention in the data. The researcher, at one point, reminded Stephanie of an activity undertaken on her course, which had not occurred to Stephanie to use as a possible solution to the problem at hand.

S: I've probably got it somewhere in all my notes from last year but I couldn't put my hand on them.

S: No I've got them all filed away ...I don't dare throw anything away, but I know if I do ...I'll want it (ST7).

Stephanie, a hard working, diligent student, had not made the connection between aspects of her course and the classroom problem she faced. It was almost as if she has unconsciously said to herself the teaching course was over and has put it to one side before starting a new section to her life. They were separate and, in her mind, unconnected. The knowledge was possibly held at a very superficial level and could not, at this later date, be recalled.

## Pedagogical knowledge

Stephanie had completed a one-year Graduate Diploma in Primary Education course but, as has been suggested in the previous section, it had had little explicit influence on her early mathematics classroom practice. What actual pedagogical knowledge had she gained from the course and how much of a factor was this on what she actually did in the classroom in her mathematics lessons?

As might be surmised after only one year of teacher education, Stephanie had limited knowledge and experience of pedagogical techniques. Many of her classroom problems could not easily be solved because she lacked the necessary pedagogical knowledge usually gained from considerable classroom experience to develop optional methods. She was thus forced to remain within the confines of what she knew and had seen or experienced.



To find alternative approaches or strategies would have necessitated searching her teacher education notes or resource books. Here again the time factor, or more precisely a lack of time, played a limiting role in this issue.

S: ...because I haven't had time to organise something different for them [more able children] (ST7).

One of the reasons for Stephanie not using, for example, manipulatives in an activity or alternative assessment methods, was that she did not know how to do it. She did not have the pedagogical knowledge to allow her to do something else.

S: I don't think ...I mean apart from MAB blocks which we use ...and fraction walls ...and using counters and things is OK for the basic facts and multiplying rules but when you get down to things like this [long multiplication] it's really hard to ...how can you possibly introduce that concretely? (ST7).

Assessment as mentioned earlier was limited to pencil and paper testing, as she did not know of alternative ways.

S: Assessing mental computations ...that's one I've got a bit stuck on ...They've got a bit better at saying here's how I did it but still apart from sort of one on one individually talking and saying, "What did you do and how did you do that?" (ST7).

Sometimes the lack of knowledge showed in more subtle ways. A technique that many teachers use to produce tasks for children is to generate a number of similar but different ideas from one basic idea. This is useful for extending children's thinking within the same situation. Without this pedagogical knowledge, teachers soon exhaust their bank of activities and much of their work has no depth of thinking and understanding. Stephanie was unaware of many of these techniques.

For Stephanie, there was also a limited knowledge of how teaching ideas could be used and how connections could be made with other aspects of mathematics. An example from the data showed Stephanie did not do any puzzle or problem work, even though she thought it would be good to do so, because she cannot make the

connections to the mathematics syllabus. She was not able to recognise the mathematics within problem situations or to see their mathematical worth. The important role of the 'fellow worker' in this situation will be discussed later in relation to the professional development support model.

Planning, programming and organising were areas that Stephanie changed during the first year of teaching. She felt that she had very limited knowledge of how to plan and organise for mathematics when she began working at the school. Her comments from the last meeting in November when she was reflecting on what she needed to know showed this point.

S: It would have been good to just have heard from someone else how they organised their mathematics teaching ...just sort of where to start and how to divide the time you've got up and how to work out which bits of the syllabus you would like to cover when. Not that you'd do it that way, but just sort of see what someone has done and like OK that's one way of doing it ...(ST9).

Stephanie's restricted pedagogical knowledge was a large limiting factor in what she could attempt. She generally could not work in ways that were different from the traditional method because she had limited knowledge of how to proceed with them and had little or no experience of seeing them in practice. She planned directly from the syllabus because this was what was obvious and relatively easy to do. She became hooked onto the 'covering the syllabus roundabout' because she had limited alternatives for action. The university course had a section on planning and programming, but as noticed earlier it had very little influence on her practice.

## Professional development

Aspects of this factor were discussed earlier in this chapter and again demonstrate the interrelated nature of the factors. Professional development was part of a school initiative and came early in Stephanie's first year. Although Stephanie was a hard working, committed and interested teacher there appeared to be very little influence of the focus from these professional development activities on her classroom practice.

Generally, the ideas under discussion were too advanced for Stephanie's thinking at the time. She was concerned to survive, keep the children under control and cover the syllabus. The professional development was emphasising assessment by task and work samples, grouping children by ability, and planning based on measurable outcomes of learning rather than syllabus covering and pencil and paper testing.

The mis-match at the time was huge and hence had little or no influence on her pedagogical practice. Later in the year aspects of the professional development started to enter the dialogue at meetings and started to move into the classroom.

S: I think developing the language and the talking together is important. I'd like to start moving into using a journal of their maths rather than just bits of paper in files. Next semester. And they are going to have to be sort of talking so they can begin to develop on a written level (ST5).

Other influences from professional development activities started to enter Stephanie's thinking.

S: I quite like the idea that ... one of the sections at that conference is having someone as Dr Maths and someone with their wrong sum and someone to explain ...(ST8).

S: That's why I was so impressed with Tiffany's comment [at the case methods meeting] that sometimes there are kids that even when it's [the answer] right teachers will say, well are you sure (ST9).

Over the year, the professional development programmes she attended had some influence on what she did. Professional development which worked at a general level of offering encouragement and showing that there were other ways to approach classroom teaching appeared to have some influence on her pedagogical practice towards the end of her first year of teaching. This influence, mainly of the professional development support model, forms the focus of Research Question Three and will be discussed later.

## Mathematical content knowledge

Generally, Stephanie reported that she liked mathematics and felt that she was good at it. She was more comfortable with number than with aspects of shape.

S: I'm not a spatial person at all. I'm big on numbers and things  
...(ST5).

Data from the beliefs questionnaire show her to be confident in her mathematical ability. She had a good background in mathematics having studied it at Year 12 level and as part of her university course. There was little influence on her pedagogical practice. Stephanie was confident enough in her own mathematical ability to be able to move away from a strict adherence to the textbooks which were available in the school, and to be able to translate the syllabus entries into activities. Many teachers who are not confident in their mathematical ability tend to keep close ties to a textbook. The textbook then becomes the substitute for the teacher and acts as the teacher and giver of knowledge about mathematics.

Over the year Stephanie worked on the content areas she liked first, possibly reflecting not only her liking of them, but also a confidence in understanding them. The areas she did not like, she left to the end of the year.

S: ...and I'm not really looking forward to the third term ...I've  
left all the horrible bits to the end ...(ST7).

Stephanie's confidence in her mathematical ability allowed her eventually to move away from dependence on commercially produced materials. As the year progressed, she developed activities and a teaching style more appropriate to the needs of the children in the classroom.

## The researcher

The role of the researcher cannot be dismissed as a factor that might influence Stephanie's pedagogical practice. The role of the researcher as a 'fellow worker' or 'support teacher' was deliberately established as part of the professional development model. See Chapter 3 for a fuller discussion of the role. This role and the influence will be discussed and evaluated in more detail later when Research Question Three is

considered. In general, the role was one of listener, helper with reflections, clarifier and when asked provider of resources. A progression can be traced over the year of the project. In the first half of the year, while options were asked for and offered, very little actually became classroom practice. The options were not necessarily rejected at that time, but rather syllabus coverage and survival became more important. Having someone available, who could respond to questions, offer alternatives to problems and save time by providing resources in the form of ideas and possible activities, gradually had an influence on what happened in the classroom. This was especially so in the second half of the year.

L: Do a model. You know, have I shown you the gridding model?  
If you have ...let's do a simple one  $2 \times 3$ . If you use squared paper  
and draw it on there ...(ST7).

The gridding model explained here was tried by Stephanie and produced good results with the children.

S: Yeah, and that's worked fantastically well for the kids ...for most of the kids after a couple of goes. We did lots of them and they drew up squares and they worked out sums and added them up and then we sort of went to "OK here's another way of writing it up", and they can now, pretty much all of them, ...after three weeks can get one of those sums and you can say, "You can do it".

S: That was really good ..I looked at it and I thought, there's no way they're going to make these connections, cause they don't even understand that ...they weren't understanding that  $280$  was  $200$  plus  $80$  a lot of the time ...but they seem to have got that part of it (ST8).

The support from the researcher allowed Stephanie to try something, to put her toe in the water, to try to develop the idea of visual imagery with the children, where the children could visualise the abstraction contained in the symbols. She started to move away from a strict, rote learned, procedural model of teaching to one that started to emphasise making connections, finding relationships and developing understanding

by the children. This success led to Stephanie wanting to try similar ideas in other mathematics lessons.

The researcher did not really have an impact on pedagogical practices until the beginning teacher was ready to accept the option of other ways to work and the confidence to try them out with her children.

## Summary

During her first year of teaching, Stephanie's classroom practice was influenced in two almost distinct phases. In the first phase, approximately the first two terms of her beginning year, the children in her class were the main influencing factor. This, however, was not a simplistic factor. It was much more complex, with the children and their behaviour and reactions implicitly controlling what Stephanie did. Her need for control of the children's behaviour was paramount. Children's poor behaviour or Stephanie's fear that they might 'get out of control' meant that she kept to a teaching style that was of a traditional format. In this way, she felt that she could govern more easily what the children did and how they did it. Lack of enough time to cover all of the syllabus content was another factor that governed much of what Stephanie did in the mathematics classroom. Practices that were quick and easy to assess were adopted so that a large amount of syllabus material could be taught in the relatively short time of a year. The context for her teaching—the school—exerted influence on what she did and how she did it. Stephanie assumed much of this influence, as the school or the Principal gave no explicit instructions as to how to teach mathematics. A lack of a large data bank of teaching ideas and different teaching styles meant that often she was not able to adopt other or more appropriate practices as she was unaware of their existence. She was left to rely on what she knew, which was often based on what had happened to her in the classroom at a sub-conscious level. However, throughout the year there was a strong influence of Stephanie's underlying beliefs about mathematics. Her beliefs, which appeared quite strong, were often in conflict with what she was being offered by the children's responses and options from other people.

In the second phase, the last two terms of the beginning year, Stephanie became less concerned with control and began to change her pedagogical practice. Many of the

factors from the first phase were still influencing her practice, for example, the felt constraints of the school context and the need to cover the syllabus. The children were an influence, but in this phase, they were more likely to help with the change of practice by their reaction to activities. Where their reaction was positive then Stephanie was more inclined to repeat the task or teaching style, as it was seen to be successful and did not cause discipline problems.

## Research Question 2

*To what extent do the following factors influence the pedagogical beliefs of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's behaviour and reactions;
- the beginning teacher's own education;
- professional development;
- the researcher; and
- other sources.

Teacher beliefs about mathematics, mathematics teaching and mathematics learning singly and in combination play an important part in the actualities of daily classroom life (Ernest, 1989; Lerman, 1990; Thompson, 1984, 1992). This section will consider the beliefs held by Stephanie about aspects of her first year of teaching and the influence of these happenings on the development of her beliefs. In particular, the discussion will highlight where beliefs have governed what has happened in the classroom and how classroom events and other associated factors have influenced beliefs. This will be the style adopted in the rest of the case studies reported in this study. The impact of the professional development and support model on these beliefs will form the discussion of Research Question Three in the next main section of this chapter.

## Children's behaviour and reactions

Early in the first year of teaching Stephanie's practice was influenced by her beliefs about children and mathematics. What appeared to be happening was that Stephanie was making assumptions about her class based on unsubstantiated thoughts about the children. These thoughts came from her idea of children in general and not specifically from the children in front of her.

Things were done; styles of teaching adopted and content used because "this is what these sort of children need"(ST3). In the first two terms, she did not move away from a traditional style of teaching because the children, she believed, would not be able to cope with such a change. One might question whether it was the children or the teacher who could not cope at this point.

S:—They haven't got much concept at all of those sorts of things like adding ten and that sort of thing and as far as mental maths goes, they just know some tables, but they haven't got very good concepts. Things like even numbers and numbers that make ten and patterns and that sort of thing (ST5).

Later as Stephanie became more confident and secure in her working with the children in her class she began to 'know' them better. From this point, possibly around the start to the mid-point of Term Three, she began to try other ways of working, for example allowing for discussion and pair work within her lessons. Her belief about what "these sort of children" could do started to change. She was dealing with, thinking about and planning for specific children, not children in general.

S: I remember the first session, coming back absolutely beaming, thinking wow, it actually worked, they are actually talking ... (ST5).

Because of the successes she had with discussion strategies, her belief about the children and what they could do changed. The success from activities with the children gave her the motivation to change her pedagogy.

The model of change outlined by Ellerton and Clements (1994), as discussed in Chapter Four, noted that it might be possible to influence and change beliefs. Change



in beliefs, they suggested could happen if enough ‘good’ experiences could be had by the teacher at the ‘hot end’ of the cycle. These positive experiences, which deal with attitudes and emotions, are more open to change than they might be when they have been repeated, to become beliefs. It appeared that Stephanie was beginning on that change cycle with positive experiences starting to make her look afresh at her beliefs about children learning mathematics. She had had positive reactions from the children to her use of pair work. The children did not become a control problem and actually worked together quite well to achieve her desired learning outcomes. Through these experiences, she was starting to develop new beliefs about teaching mathematics.

### Teacher education course and school experience

Previous work (Sullivan, 1989a) noted the lack of influence of teacher education programmes. He cited evidence of the fact that, while teacher education courses exposed students to situations that questioned their beliefs, students filtered out much of what they heard and experienced on the course. They generally moved into their first year of teaching with their beliefs about mathematics and mathematics teaching intact and largely unaffected by their teacher education course.

Evidence, or lack of it, from the interviews with Stephanie may confirm this trend. Stephanie rarely mentioned her teacher education course in informal conversations and interviews. School experience, as part of the course, seemed not to have had an overt or strong influence on her beliefs about mathematics and mathematics teaching and learning. There is no evidence from the interview transcripts that her school teaching experience influenced her pedagogical practice.

The literature and especially the work of Lortie (1975) pointed to the strong influence of the teacher’s school experience as a pupil on their later classroom practice due to the beliefs about mathematics and mathematics teaching established during this time. Stephanie mentioned a memory of a primary school teacher who made mathematics fun and did puzzles and games as an influence on her thoughts and beliefs about mathematics teaching.

## The present school context

The school context generally confirmed a traditional belief about mathematics teaching and learning—that is, mathematics is done quietly and on one's own. That is mathematics teaching is not to do with children talking, apart from giving the answer when asked by the teacher.

S: In other areas, yeah, it [group work] shouldn't be too hard. But talking in maths is harder because it is 'shush, be quiet'.

L: By you or by everyone?

S: By everybody. I do it as well, but ...(ST4).

Stephanie adopted some of the practices used elsewhere in the school, for example the use of a textbook, whole class teaching and black line masters for children to complete. Some of the practices she adopted because she believed they were right and, as they were already in the school, she was confirmed in this belief. Others she gently questioned but continued to use possibly for other reasons, for example, the use of 'speed maths sheets'. These were questioned, maybe because she perceived that the researcher disliked them as the only teaching vehicle for mental computation, but she adopted them for control reasons rather than an explicitly stated belief in their pedagogical and educational worth.

## The researcher

Most of the points related to this factor will be discussed in the later section concerned with Research Question Three and the professional development model. Here the evidence of direct influence, by the researcher on the beliefs of the beginning teacher, was scant. Influence was considered under two groupings. Firstly, the researcher's role as a teacher education lecturer in Stephanie's mathematics education course and, secondly, as a visitor to Stephanie's classroom. As noted in the previous section related to teacher education, any influence that there might have been on beliefs could only be surmised from Stephanie's comments. These must also be considered from the stance that they might have been said, in some way, to

acknowledge the researcher, but had no real impact on more deeply held beliefs by Stephanie and her initial pedagogical practice.

## Professional development

The amount of professional development, apart from the reported project, undertaken by Stephanie in her first year of teaching fell into two groupings. First, she was part of the school project related to the implementation of the Western Australian Student Outcome Statements, and second, she organised and attended smaller sessions for herself, mainly later in the year.

Ideas gained from professional development courses appeared to have little influence on her beliefs about practice initially. The Student Outcome Statement project, as noted under Research Question One, appeared too advanced for Stephanie's thinking and concerns at the time. A later experience at a mini-conference on research findings in primary mathematics actually appeared to be more influential on her thinking and practice. She spoke of some of the activities, for example, a problem solving exercise involving a mystery bone. She was accepting of a way of working in mathematics that did not match her underlying traditional belief about mathematics teaching.

Generally, however, her beliefs about mathematics teaching appeared not to be influenced in any major way by non-project professional development in her first year of teaching.

## The beginning teacher's education

Evidence was available, in explicit terms, for only one reference to her schooldays' mathematics education. Here she talked of making mathematics fun and the teaching of mathematics not being "here's the way we do this sum". She spoke of her beliefs that mathematics should be fun, and that mathematics teaching should contain puzzles and problems. She said that mathematics learning should take into account the mathematical needs of the child.

## Summary

Stephanie's beliefs about pedagogical practice in mathematics appeared to remain almost intact throughout the year. At the start of the year, she had quite traditional beliefs about mathematics teaching. Teaching, for her, was to do with the transmission of facts and skills. A good teacher was therefore one who could break the knowledge down into memorable pieces for the children and could explain procedures clearly. The context of the school confirmed these beliefs. Rarely were beliefs brought into conflict or challenged in the first part of the year.

In the latter part of the year, she started to work with other teaching styles. She began to understand the children more clearly and from this growing knowledge, her initial beliefs about teaching were challenged by the evidence of the responses given by the children. Thus, success and the positive responses from the children influenced her beliefs about pedagogical practice in mathematics. The positive responses showed that other ways of teaching mathematics could be effective. As these emotive responses were repeated over the latter part of her first year of teaching so her attitude and belief about how to teach mathematics also changed. This followed the change cycle outlined by Ellerton and Clements (1994).

## Research Question 3

*To what extent is a teacher empowerment model of professional development, with 'fellow worker' support, an effective way to help beginning teachers develop as professional teachers?*

This section will discuss the interaction of the professional development model and the beginning teacher, in this case, Stephanie. A more detailed discussion of the background to the support model can be found in Chapter Three. The following discussion considers each of the fundamental features of the model, empowerment via options, reflection, and experimentation by means of action research. It will evaluate their effectiveness in developing change and offering support for the beginning teacher. The first part discusses the options and teacher empowerment principles of the model.

## The professional development support model

One of the major features of the model was that the beginning teacher would decide on the issues to be considered and the researcher or 'fellow worker' would not dictate what should be done. Only options, or a range of possibilities for action, were to be suggested by the 'fellow worker'. From this range, the beginning teacher would select an action to implement in the classroom. In this sense, the teacher was empowered to make decisions about what issues were important and what would happen in the classroom.

The feature of the 'fellow worker' offering options for practice was strong and appeared to be a useful role. Stephanie, the inexperienced beginning teacher, was supported by the deeper knowledge of the 'fellow worker'. The idea of offering a range of possibilities for working on a problem was a move away from the beginning teacher's normal experience of being told exactly what to do or imitate. The following comments indicate this approach.

L: What I think I'm doing here is giving you a whole pile of things that you might be able to select from. And you decide. So it's a matter of choice rather than me saying, well that's what you should be doing (ST4).

L: McIntosh and Reys have got a new series of books out on mental mathematics. Level 1 to 4 I think it is ...I'll see what I can find. Let's see what I can think off the top of my head. You can do 'Today's number is', and variations. You can do 'How did you do it?' You can do 'I'm thinking of a number between 1 and 100'.

The difficulty with that one is getting everyone involved (ST5).

At times too many options might have been offered by the 'fellow worker' in a very short time which could have left the beginning teacher somewhat bamboozled and overloaded with information. Comments from the 'fellow worker' journal, especially following the early meetings of the project, noted a tendency to talk too much and to dominate the proceedings and not offer the beginning teacher enough time to contribute to the thinking. An enthusiasm to help overwhelmed the meeting and the beginning teacher, and may have been a factor in the non-implementation of the

options. With hindsight, one could suggest that a style of 'less but more often' might have been an alternative to the feeling of overload. That is, less options for action would be given at any one time but meetings for discussion would happen more often.

A feature of the model, used more diligently in the early stages of the project, was to send a memorandum of understanding of what had happened at the meeting, along with any promised materials. This had the dual effect of reminding the teacher of what was discussed and who should do what, along with a clearly set out list of options for action. This went some way to alleviating the overload of the meeting. Below is an example from later in the beginning year where the actions to be taken are summarised at the meeting.

L: ...I'll have a look and if there's anything useful I'll copy it and send it to you. O.K., so I should be sending you something on assessing. ...maybe some maths ...I'm not sure what I can find but ...if I can find the stuff on grids as well as stuff on multiplication and division, transformation and mass (ST7).

So often the beginning teacher left the meeting with nothing concrete, nothing written down, only a head full of a conversation. The memorandum acted as a jolt and a stimulation to recall the conversation.

At first, the options for action were not taken up in the classroom. Stephanie was more concerned with control and survival than with suggestions for improvement, although she had asked for them, and was a partner in their emergence. The issue or problem identified remained for the teacher, but it could not be attended to due to other more pressing concerns. With the demise of the concern for control later in the year, the idea of options for action was more successful. From Term Three Stephanie began to try some of the options. Generally, these were successful, in the sense that children reacted in positive ways, and Stephanie noticed useful learning by the children.

Another feature of the support model was that of teacher reflection. The next section will consider how successful the 'fellow worker' was in encouraging reflection by the

teacher. Reflection by the teacher used the second feature for change identified by Clarke and Peter (1993).

## Encouraging teacher reflection

Part of the underpinning of the model was to encourage beginning teachers to reflect on their pedagogical practice. The purpose of this aspect was to help the teachers develop this as part of their practice at an almost automatic level. This followed Schon's (1983) idea of *reflection-on-practice* leading to *reflection-in-practice* so that the day to day decisions of the classroom might be made on rational and considered reasons, rather than a knee-jerk reaction. The notion of reflection would also incorporate part of Clarke and Peter's (1993) factors for change—namely teacher reflection.

Generally, questions to encourage reflection and deeper thinking about a classroom situation were quite open in style:

- Why do you think you made that decision?
- What's caused them to come to this sort of idea?

Sometimes, however, they were specific and returned to the teacher, in quite stark ways, a statement of exactly what she was doing.

L: So let me be unkind and take this sort of reflection, that in order to placate the next teacher and be able to say you have 'done it', that you're a good teacher, you are going to rush through it [a piece of learning] (ST7).

L: So there's this dilemma all the time isn't there, whether you should get through everything or whether you should go slow enough to make sure the kids understand it (ST7).

At other times, questions were asked to help the beginning teacher reflect on what had been done about the problem identified in an earlier conversation.

L: We talked a while ago about assessment via a task ... “How big is your foot?” type ... Have you done any more of those sorts of things? (ST7).

L: So going back and thinking, and I think our initial conversation was you actually wanted to know where to start with kids and what they knew. Do you think something like this [children working on an open task], assuming you are going to finish doing the analysis, do you think something like this is helpful? (ST4).

Questions to encourage teacher reflection were often designed to remind the beginning teacher that she did know about some large and significant ideas.

L: ...how might you want to work with these kids, what would be effective to work with the particular kids you have here, if you didn't have the constraints? (ST7).

Reflection was used as a way to consider the noted constraints on teaching and to try to see beyond them. Often limitations were suggested by the teacher which, in reality, did not exist in any demonstrable way and could be easily by-passed.

L: But a lot of group work is about training kids to work in groups. Now you seem to be suggesting they work reasonably well on all but the second part, let's just talk about the first part. They seem to get into that reasonably well (ST5).

Here the successful feature was highlighted for reflection, so that the positive experience was not lost in the possible overall feeling of defeat. This was then developed as an aspect that the beginning teacher might like to repeat to receive the positive response and a change in belief following the Ellerton and Clements' (1994) model for change in teachers' belief. Reflection was used to have the beginning teacher re-visit areas and experiences that might have influenced her beliefs.

L: So before you actually started teaching what sort of things do you think influenced what you thought about teaching, you thought about mathematics? (ST8).



L: Let's just shift a bit ...the same sort of question. What sort of influences have you had? Things that have influenced you since you started teaching? So I guess since you've been here? (ST8).

L: ...What incident might you remember that had a direct bearing on what you do with mathematics? (ST8).

Pedagogical practice was constantly being evaluated via the need for teacher reflection. Reflection questions were used to feature the need for rigour and thought in teaching.

L: ...The kids have done this and it's all very nice thank you very much but what the heck have they learned. I'm trying to remember back to conversations we've had here in March and you seemed to be saying quite different things about what we've tried and what's happened (ST8).

Asking generic reflection questions developed teacher self-reflection, an important feature of a professional teacher. Such questions often featured in the conversations.

L: It would be interesting to, maybe at some stage to say, "Why is that good"? Is it because you don't have to do very much or is it because you had a good time and you learnt ...(ST8).

L: Are there other things that you feel would be characteristics of effective ways to teach it? (ST9).

Features of changed or developing practice were highlighted to help the beginning teacher realise that she was actually developing into a different teacher and to see the journey she had undertaken.

L: So before what might you have done though, you would have gone through the method, the procedure? (ST8).

L: A very general question ...you've probably said most of this already. If you're now able, at the end of Term 4, to look back to you at Term 1, Term 2, how do you think you've changed,

developed, matured whatever words you like? What are you doing now that you didn't do then and what were you doing then that you don't do now? (ST9).

Thoughts were also given to teaching in general, for example, teaching other subjects and considering what assumptions were made there but not in mathematics teaching.

L: One of the things we talked about on Saturday was about teaching mathematics and teaching other subjects. So is teaching mathematics the same as teaching language or is it different. And if it is different, how? (ST9).

This aspect of the support model appeared to be useful and successful, in that it established a culture of thought and reflection about pedagogical practices. The next section will consider the type and quality of teacher reflection that was achieved as a result of the professional development model being used.

## Teacher reflection

The ability to reflect on one's pedagogical practice is arguably a feature of a good teacher. Through the use of questions, the model hoped to engage the teacher in reflecting about her practice and from this reflection develop a deeper insight into her teaching and classroom practice.

For the beginning teacher it was difficult to find time to reflect on what had happened in the classroom. One of Stephanie's major concerns, noted earlier, related to the lack of enough time to do all the things she wanted to achieve.

S: There's so much time just getting through day-to-day and to do in the day that you don't have time to really sort of plot and think a lot about what you are doing (ST7).

The fact that the support teacher had organised a visit meant that a commitment was given and a time found. Thus, the reflection process could begin. Without the catalyst of the professional development model, one could suggest that the time for reflection

would not be found. Teaching successes and failures were considered and from these incidents, positive features were noted.

S: We did that [mental computation] today actually, we did it yesterday and the trouble is I did two strategies at once which is a big mistake ... (ST7).

S: That was left to the group. And it was quite interesting using paper, I think we had three sessions, like they started off really well and there were four groups and they did all different things. One group began cutting out triangles and then one group traced around them and one group actually worked out that one triangle was double the next one, and was double the next one and did it like that and did it very quickly. But we then had to stop and we started again the next day or a couple of days time and that really just threw them (ST4).

As the reflection process continued, Stephanie became more aware of the abilities of the children in her classroom. Talking incidents through with another person appeared to clarify aspects of what had happened and provided insights into children's thinking and understandings, and also, into the complexity of the task of teaching. The following example from the transcript illustrates the development of such an incident. The narrative-like features of Stephanie's report add naturalness to the reflection. It was this ability to 'see' the children in a different way as individuals rather than as a homogeneous mass that led Stephanie to consider other ways of teaching.

S: Um, let's see, there was one girl who, she actually, a lot of them worked out that you had to work out how of certain things to put in there but one girl actually worked out that she had gaps and she knew you couldn't have, you couldn't have gaps, you couldn't work out gaps and she actually came up with using plasticine. And have you got any plasticine I can use to fill in the gaps. And so that was, I thought ...

L: What? So she squished the plasticine up?

S: Yeah so she ended up, and then she ended up, then she realised that she couldn't measure how much plasticine she'd used. So then she actually made her plasticine into two centimetre little worm things, the long bits, and then she sort of put those in and curled them round and did it that way. And she was the only one who actually, explicitly came out and said, but there's gaps. And like, no I can't have those, what shall I do about that? And that was quite, that was quite good thinking. A pleasant surprise I suppose.

L: So going back and thinking, and I think our initial conversation was you actually wanted to know where to start with kids and what they knew. Do you think something like this, assuming you're going to finish doing the analysis, do you think something like that is helpful?

S: Yeah, because there were some kids who had that kind of understanding and some kids who didn't some kids just put the round counters and then counted how many counters and didn't care if there was bits left over. Yeah, like I would probably say, yes that kid knows space and that kid doesn't. Maybe two groups in the classroom than have one lot.

L: So that sort of development about knowing about space and, and not knowing and then, what, what about the fact that if they were using counters or something, oh I'd better not write on there. And but, the counters don't fit nicely in bits like that. Were, do, were any kids like, how did they, how did they talk about that?

S: No, they tended to work, when I was watching them I found that they actually tended to do, they went round the edge first and then filled up the middle. So rather than having anything overlapping out they left holes in the middle rather than going out so, and we'd done a little bit of work on perimeter which might be why they did that. They immediately went, going round, like inside but round the edge, on the inside first.

None had any gaps on the edge. Some had on the squared paper, some had squares that stuck out and they just counted the bit on the inside was part of a square. And they looked at ways of trying to match up parts of a whole square.

L: Okay, so there's another level of sophistication isn't there? Mm. Do you think, okay, having just had a flick through, do you think you will be able to generally group those kids into, what maybe, three groups? Or two groups based on what we know about that? (ST7).

Insights into pedagogical practice and the possibilities of other, maybe more effective, ways became apparent as Stephanie's reflective talk continued. She was now beginning, not only to consider the differences in the children's ability, but also, how she might change her teaching methods to develop the affective and social aspects of children.

S: Or even sort of sentences, half, you know, "I used" and then a gap. I guess too, even though they were in small groups they were actually, it was how big is my foot, not how big is one foot, you know, even though they were working in groups, they were still all actually measuring so maybe if they were, you know, all told to pick one person out of the four and find out how big their foot was, they might have to do sort of more talking to each other and that might have made writing easier and marking easier (ST4).

S: Probably have to mean lots, be a lot more, giving positive feedback, and especially at the beginning, it's a case of trying to get their confidence up to discuss even more than usual (ST4).

As the first year of teaching ended, the ease of reflecting by Stephanie had increased and it began to have an impact on her classroom pedagogy. She started, for example, to question the traditional, procedure-orientated teaching style she adopted early in her beginning year.

S: It would have been good to get the kids talking and writing about their maths from the beginning. I started a bit of it towards the very end of the year, but it was ...and that was good and that sort of seemed to get the kids thinking a bit, and also helped me understand what they knew and didn't know ...but I didn't do it till the end of the year (ST9).

S: ...Quite often kids have got the right answer on the bit of paper, but when they actually try and tell you what they've done or how to do it, they haven't got a clue what it means or what it is, and they have been able to do it right, they don't actually know what they've done or why they've done it (ST9).

She not only talked about doing something; she actually put it into practice in her classroom. This, however, cannot be aligned to a straightforward cause and effect situation, as there were many factors affecting the situation in a very complex fashion at any one time. The professional development model of this project, with its focus on teacher reflecting on practice may have been a contributing factor in Stephanie's development and growth as a teacher.

Stephanie saw the support model, with its in-built need for reflection by her, as a positive and useful thing for her as a beginning teacher.

S: It has certainly got me thinking about what I do, which is good.

L: Hopefully I have not told you what to do.

S: No you haven't, but it's been good. Quite often I think "I don't know what I was doing or why I was doing it that way".

L: So sort of helping you to develop just sort of reflecting?

S: Yeah, yeah ...and that's lead me to think then ..."I'll try doing something else".

L: Maybe it's something to help you know what you don't know. We talked earlier about you not knowing what to ask for because you didn't know what you wanted (ST9).

With Stephanie, the important feature of reflection on practice had started and the results of it were beginning to be incorporated into her everyday practice in mathematics teaching in the classroom. One part of the Clarke and Peter (1993) model was being undertaken. The other feature, experimentation, is the subject of discussion in the next section.

### The action research model

A further feature embedded in the professional development and support model was that of action research. In the design of the model the action research aspect was seen as a way to incorporate two important features of classroom change—teacher reflection and teacher experimentation (Clarke & Peter, 1993). The action research cycle of plan, act, observe, and reflect provided an excellent vehicle to undertake these features.

In practice, each meeting would undertake a review of the action research cycle. The action from the previous meeting would be reflected upon and reviewed before a new problem was identified with its connected action designed by Stephanie as a result of our discussion. Such a discussion is illustrated below:

L: The thing that we're trying was the open task to find out where children were. And you were showing me some stuff last time. How have you developed from there (ST5).

L: Maybe, maybe another option is that you do quite a bit of pair work and then gradually work - that might be one way. Um, other options, what other options? Certainly your point about having slightly smaller groups I think is an important one but, making it so that if they're doing reporting, that you're not, you don't actually say who's going to do the reporting. So we have to make sure, our group has to make sure that everybody knows what you have to say. Maybe putting in some rehearsal time. Um, things

like, okay it's going to be reporting back in five minutes, ten or whatever, the task now is to make sure that everybody knows what problem we had, what we're trying to do, what happened and what we found out. Probably some structure from the, from the headings. And then you still select somebody to report which also helps in that you could keep a record of who's done the talking, and you could have somebody else next time. So everybody else, everybody gets a chance at this, this thing. Mm. Are, are you, do you think you're happier to try some more open-ended type things (ST5).

The action research cycle tended to break down in the early terms of the beginning year. Often the proposed action did not take place or took place in a truncated form, due to any one of a multitude of factors, but mainly Stephanie's need to control the class and survive. Taking on another thing or even thinking about it was given a lower priority to the need to survive. After about the third meeting the action research cycle in its formal form was abandoned. It was replaced by an informal system, which asked about what had happened in the classroom since the last visit. The idea of reflection was useful here but formal, planned experimentation was difficult to achieve. The experimentation aspect of the Clarke and Peter model may be useful with more experienced teachers but proved to be difficult to implement with beginning teachers in this study.

The question remains, however, did any change take place in Stephanie and in her pedagogical practice and could this change be attributed to the support model being used with the beginning teacher? The next section will consider evidence to provide an answer to that question.

### Aspects of change in the first year of teaching mathematics

In this section, change is considered from two standpoints: change in the beginning teacher—Stephanie, and change in her classroom practice.



Teaching style in mathematics at first tended to be directed to the whole class with everyone doing exactly the same activity and with the same learning objective as an outcome.

S: Yeah, maths, I don't tend to do much group work, it's the one area where I don't do any so that will need changes (ST4).

Later, through the support offered by the model, reflection and experimentation leading to positive experiences, Stephanie had changed her classroom practice. She now began to use group work with the children, and at times, each group had a different task to complete. There was also a change of emphasis. The children in some situations were required to think and to solve simple problems. This was in contrast to the earlier teacher lead style of teaching where the children merely followed instructions.

S: That was left to the group. And it was quite interesting using paper I think we had about three sessions, like they started off really well and um, there were four groups and they all did different things. One group began cutting out triangles and then one group traced around them and one group actually worked out that one triangle was double the next one, was double the next one and did it like that and did it very quickly. And um, but we then had to stop and we started again the next day or a couple of days' time and that just really, really threw them (ST6).

This was an example of one of the first positive experiences that Stephanie had. It was well towards the end of Term 2, almost half way through the first year of teaching. Here she was using groups as an organisation rather than whole class teaching. Children were expected to think and solve problems. The success in this activity appeared to spur Stephanie to try similar things again, but in future attempts she had learned from her previous experience via reflecting on it. Although it was not wholly successful, it seemed that the combination of the support person and teacher reflection enabled Stephanie to salvage something positive from the experience. This positive experience was a catalyst and a motivator to Stephanie trying a similar task or teaching style again.

Talk by children as part of learning mathematics gradually became a feature of her pedagogy over the beginning year. Initially children worked 'on their own' and generally worked in silence. Stephanie used the first part of the year to establish control and to outline her expectations of the children.

L: You were just saying the kids now know what to expect?

S: Yeah, the control's there, and they now know what I expect so I don't have to sort of spend so much time on sit down, be quiet, rule up like this (ST4).

The development to group work and to children discussing mathematics was not an easy transition for Stephanie. Not only did she have to believe that it was worthwhile, safe and that the children would learn something as a result of it, she also had to teach the children to socialise and co-operate with their peers.

S: It did, yeah. Towards the end of that first session, they began almost breaking up and making little pairs and things rather than working as a whole group. And so by the next session they were all sort of off and kept going off and working in twos and threes and fighting and arguing and things (ST5).

She persevered with group work and children talking as she wished to incorporate aspects of children writing about mathematics. The use of talk was a necessary rehearsal for writing. Her comfort with aspects of language teaching allowed her to move into similar ideas with mathematics. The comparison of language and mathematics teaching during reflection with the 'fellow worker' opened this avenue to her experimentation in mathematics.

L: And open ended ones with that, that sort of language base.

S: Yeah. I think developing the language and the talking together is important. I'd like to start moving into using a journal or even sometimes more of a book or a journal of their maths rather than just bits of paper in files. Next semester. And they're going to

have to be sort of talking so they can begin to develop on a written level (ST5).

L: So the kids were coping with the slightly more open stuff, the thinking stuff. They were coping with a more active style of working. You were managing it (ST8).

The writing and explaining continued to develop as Stephanie employed more group work and an emphasis on children talking, reporting and writing in and about mathematics.

S: Yeah, their writing has actually got a lot better. They find it hard ...they've got better now. They used to find it very hard to actually explain ...or to know what I actually wanted them to write about ...I mean at this point I think they're still a bit vague on it, but they've got better ...And writing up what they've learnt I suppose that is a bit abstract ...to sort of think about ...or I learned not to bump into the table (ST8).

Stephanie's reflection at the end of the year noted this development and the value of children thinking and talking about mathematics.

S: It would have been good to get the children talking and writing about their maths from the beginning. I started a bit towards the very end of the year, but it was ...and that was good and that seemed to get the kids thinking a bit, and also helped me understand what they knew and didn't know ...but I didn't do it until towards the end of the year (ST9).

It also showed a change in her belief about teaching and learning mathematics. Teaching mathematics now involved children talking. She also developed an ability to assess their level of understanding by listening to their talk. Understanding the children's level or identifying what they knew was the first issue or problem for investigation identified by Stephanie at the first meeting. It took almost a year for her to reach a point where she implemented the necessary change in her pedagogical style to accommodate her earlier wishes.

One of the early successes in Stephanie's teaching which, in turn, led to a gradual change in her teaching style, was associated with mental mathematics. In the first term and part of the second term, mental mathematics had been of a traditional speed, instant recall format. A small change, from asking for the answer to supplying the answer and asking for a possible sum, provided the catalyst for further experimentation. She used the technique of "The answer is 12. What is the sum?" to gain some positive reaction from the children.

The 'fellow worker', as part of the professional development model, was able to offer other options for activities of a similar nature at the point where they were needed and relevant. The empowerment format of the teacher identifying a need and the 'fellow worker' being able to respond, there and then, helped to change pedagogical practice in Stephanie's classroom.

S: Their mental strategies. They're actually beginning to use the mental strategies which has been good. They have done lots of learning with very specific strategies like with subtraction ... (ST7).

L: That seems to be quite a change.

S: Yeah.

L: For you anyway. You weren't doing that initially.

S: It was something this term. I really focus on mental strategies.

S: It seems by teaching a strategy quite intensely you get kids to say "Well you actually can do it like this" and before they couldn't ... before they couldn't say "Well I did it this way", but once they had been shown one way and they heard how you can describe one way or the next ... they can describe their own way of doing it as well (ST7).

As Stephanie's confidence with her ability to control the class and her success with a teaching style other than teacher-directed, procedure teaching grew, she began to try

other ideas. She did this even where she was not convinced they would actually work. She had now reached a point where she was confident enough to take a risk of failing.

S: Probably that lesson on the types of multiplying I was just blown away I was just like "There's no way they're going to be able to make that connection between the squares and the digits", but they said "Oh yeah, that's this and that's that", all very easy. Probably that made me see that doing something like that constantly first really does actually get it ...you always knew the theory of it, but having actually seen it like clearly ...(ST8).

S: That was really good, that was actually ...and I looked at it and I thought there's no way they're gonna make these connections, cause they don't even understand that ...they weren't understanding that  $280 = 200 + 80$  a lot of the times ...but they also seem to have got that part of it ...(ST8).

Her risk taking allowed for success. In turn, this questioned her beliefs about mathematics teaching, and what the children could achieve.

She also began to offer more activity-based mathematics, which was something she had not been able to achieve earlier in the year.

S: An activity based thing. We did something yesterday where they had a picture of a 55 kg I think it is, child and they tell you the head weighs 3.3 kg and the body weighs 30 kg, what do his arms and his legs weigh? And they actually, cause they'd talked about weight they then weighed themselves and we looked at very quickly how to work out what proportion of the body was the head and the arms and things and then with their own weight we worked out how heavy their own head was, or their own feet were.

L: Mmmmm, from what you're saying it seems to be a much more active way of doing mathematics than I got the impression you were doing.

L: So the kids were coping with the slightly more open stuff, the thinking stuff. They were coping with a more active style of working. You were managing it (ST8).

The final interview gave a further insight into Stephanie's teaching change. Her initial teaching style, as has been noted, was a traditional, teacher-directed, procedure-learning method. Stephanie told the children the way to do something and they learned this so that they were ready to practise it. This was not always the case during the last part of her first year of teaching.

S: They keep hearing and they keep hearing it in different ways and different levels, so that if one way hasn't sunk in maybe another way might (ST9).

The emphasis and focus for learning moved from the teacher to the child. There was a realisation that there was more than one way to solve a problem or find the answer to a calculation. This was reflected in the underpinning philosophy of Stephanie's pedagogical practice.

Assessment, one of Stephanie's major and early concerns also changed. She identified the need to know what the children knew about aspects of mathematics. She felt that the traditional pencil and paper tests she was using were limited in the information they could offer about the children's knowledge. The initial suggestions from her professional development course and from her 'fellow worker' were too advanced and complex for her at the time of offer. Gradually, however, along with change in her teaching style, she began to incorporate other ways to assess children's understanding of mathematics.

S: The assessing I tried to include some different ways ...first and second term it was mostly just a test at the end of the unit and I did a little bit of speed maths I think ...[I've] done a lot more just observation things ...“Yes, they've got this ...no they haven't ...checklist sort of thing. I've also tried to include some kind of a practical component as well, so I take the things like the measuring perhaps, I get them to read off the container rather than saying “Here's a picture of a container” (ST7).

## Chapter 6

### **Case study analysis and discussion**

This is the second of the reported case studies from the project. It will be treated in a similar way to the first one. After an introduction, which sets the case in its context, each research question will be considered in turn. Data relating to the specific case of Tiffany will be discussed, with examples of evidence taken mainly from interview transcripts to illustrate key points.

### **Case Study — Tiffany**

#### **Setting and background**

Tiffany came into her first teaching post from a University degree course and with a Diploma in Primary Education qualification. She was twenty-three and had followed a direct entrance route from school to teaching. She completed Year 12 at school, moved to a University course, and then via a year away from study and a one-year teacher education course (Graduate Diploma in Primary Education) she entered her first year of teaching.

Tiffany's degree specialisms were in science and biology. She achieved a B.Sc. (Hons), Upper second degree in 1994. Her initial teacher education course was a one-year Graduate Diploma in Primary Education. Experience in the school setting, as part of her teaching practice, consisted of two periods of distributed practice of one day a week, followed by three blocks of time in the school. The teaching practices were with two Perth Metropolitan schools and within these Tiffany worked with a Year 2 class, and a Year 6/7 class. Finally, as part of her Assistant Teacher Programme (ATP) she worked with a mixed ability class of 31 Year 1 children. Tiffany graduated from her teacher

education course with a high mark for the academic component of the course and an award of outstanding for her Assistant Teacher Placement (ATP). Only a small number of the students achieve an outstanding mark for their ATP. These marks indicated that Tiffany was one of the more able students from the Graduate Diploma course.

The Education Department, early in January, offered Tiffany a teaching position. She was assigned to a primary school in a medium-sized country town almost two hours drive north east of the centre of Perth. The town had a mainly agricultural background, with a little light industry for other employment. The population spread was typical of a country town with a range from agricultural and light industry workers to professional families and people who commute to Perth. There was within this demographic a significant population of Aboriginal people, many of whose children attended the school.

The school was brick-built, situated on the edge of the town, with its own sports field and tarmac play area. The schoolyard overlooked the town site in one direction, while in the opposite direction were nearby wheat fields and areas for other forms of agriculture. The school was about 50 years old, with the addition of extra buildings between 20 and 30 years ago. Most of the classrooms were in line and open onto netball courts and the play area. Tiffany's classroom was self-contained and could be isolated from the rest of the school by closing the front and rear doors. It had ceiling fans but no air conditioning. The desks were quite modern and were grouped around the classroom.

There was a full time teaching staff that consisted of Principal, who had been with the school for four years, and six full-time class teachers. To this were added three specialist teachers in German and physical education, music and educational support and three part time members of staff. There were approximately 180 children spread over six classes.

Tiffany taught a combined Year two and Year three class. Children in the class were representative of the area, described by Tiffany as mainly in a low socio-economic grouping. The variation in ability level in the class, identified by Tiffany, ranged from children at Year one level to some at Year four level. A teacher's aide supported some children in the class. Tiffany felt that the children, in her reflections at the end of her first year of teaching, were sociable, generally willing to learn but a 'mixed bag' in terms of



emotions, maturity and scholastic ability. The children came from a variety of home backgrounds. For example, some came from single parent families, others were transient, and many were from stable homes.

The next section will discuss Tiffany and her first year of teaching mathematics in the primary school, under the headings of the three research questions.

## Research Question 1

*To what extent do the following factors influence the pedagogical practices of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- the beginning teacher's beliefs about mathematics, mathematics teaching and learning;
- children's reactions and behaviour;
- the beginning teacher's own education;
- professional development;
- the researcher; and
- other sources.

As was the case in the previous chapter, this section will identify and describe factors that influenced Tiffany's classroom practice in mathematics teaching. 'Snapshots' from the description of her first year of teaching will be offered as support for the statements made and descriptions given. Factors will be discussed under separate headings but the reader should realise that, in the reality of the classroom, these factors were interrelated in a complex fashion. The order of discussion will vary from that of Stephanie and later from that of Harry and Gaz because it deals with factors in order of importance to the individual cases.

## Children's reactions and behaviour

The major factor governing what Tiffany did in her mathematics lessons, was the behaviour and reaction of her children.

T: ...I went back to the first lesson I did, I think I used blocks and things like that, and that got pretty out of hand, that put me off for a while, so I went back to things that were easier to control (T7).

There was a constant struggle for the first part of the year between what she wanted to do; what she felt should be done in mathematics; what she tried to do; and what the children would allow her to do, by their classroom behaviour. She took, quite understandably, an option that she felt she could manage and control and one that would, hopefully, allow some mathematics to be taught.

I have attempted several more hands-on/exploratory learning activities and if I look past the behavioural problems, I guess some children did get something out of them. It is the behaviour difficulties that I have with 5 or 6 children that make me go for the easier option of 'worksheet maths' (Tiffany journal 4).

Within the general factor of the influence of the children were a number of sub-factors or contributory factors. These sub-factors were a large range of ability, a lack of ability or limited ability in some children, and, in particular, behavioural and socialisation problems of a few children.

Coming into the class at the start of her first year of teaching, with relatively little teaching experience, Tiffany was confronted with a 'split class' containing Year two and Year three children. She had to work with children exhibiting a range of abilities within two year groups. For Tiffany this created a problem of matching and organising appropriate tasks and levels of mathematics work to particular children.

Having a split class means that I undertake maths at different times and often I have 2 or 3 things going on in the classroom. This means that my focus cannot be solely on the maths lesson that I am doing with the Year 2s. I do have an aide, but problems arise that I often have to deal with and my attention is taken away from the lesson at hand. For this reason, I chose maths experiences that involve the children sitting together as a group and working on paper. To tell you the truth, it is just plain easier to teach maths in this class in this way (Tiffany journal).

The same issue, that her teaching approach was limited by her ability to teach and organise the variety of levels and the distractions of other issues, were strong themes during the first part of the year

T: ...Maths is difficult to do with this class because I've got a split 2/3 and I find the abilities range from early Year One to Year Four sort of ability. And I find it hard to get through the maths, it takes, it's a very slow, progress is very slow (T1).

T: I've such a range of ability levels within the one year. It's quite incredible, some of them ...I've got one girl who doesn't attend regularly and she's, you know when she does attend ...(T1).

Not only was there a range of ability but some children had very low ability and performance levels in some areas, for example, one girl could not add simple numbers. Some of the very basic ideas in mathematics expected by Tiffany of children in Year two and Year three were missing from a few members of the class. Tiffany's expectations of the performance of Year two children did not match the reality of some of her class.

T: Now Year twos ...basically they don't even recognise their numbers up to twenty yet. So, we've started right back on number and work, like numeral recognition (T1).

Other problems for Tiffany were related to the lack of general abilities in the children, which impinged on their mathematical performance, such as completing their mathematics tasks. Some of these are illustrated below.

T: ...because a lot of my kids can't read. Well they can read but reading the question is half the battle ...

L: What are they like at writing? Can most of the Year threes, can most of them manage a few sentences?

T: Most can but, we've got, I'd say half of them can. Half of them still have problems.

T: ...It's actually they don't like writing, they won't write and it's been going on for a whole term (T2).

There was also a mismatch early in the year between what Tiffany expected them to be able to do and what they could do or were prepared to do. For example, the children's pace of work, as noted earlier, did not match Tiffany's expectation based on her experience with children of a similar age.

T: ...the Year threes I'm talking about ...I guess because maybe I was expecting it to go faster than what it is, so I feel like we're doing the same thing over and over again. And, I find like, I try to do some games with them and like, you know, ...they just can't handle it ... (T1).

T: ...I mean I actually have to move on from it, like I can't keep going, I was going at a very slow pace and I've still got to go at their pace but I think I was staying too long on one thing, that's why I was feeling that way (T2).

Often she found that the children were not confident enough to work in a style that was different from their usual classroom experience. When Tiffany attempted to engage children in tasks that required them to react or respond, or to think or explain, they generally did not. They would keep quiet. In fact, Tiffany later realised that the children needed help to work in different ways; to have their confidence to take risks developed. Her initial jump straight into these tasks was too much of a change too quickly for the children and, therefore they were not prepared to take risks, and probably be wrong, with the resulting failure.

T: The things you sent me are great in theory, on paper, but what I've discovered is that my kids can't do that stuff. Not can't, I should say they need a hell of a lot more practice (T3).

One of the major constraints on her teaching style in mathematics, was the poor social behaviour of some of the children within her class. This was a general constraint for all cases reported in this study, but the issue of class control was a major one for Tiffany. A control issue for Tiffany was one of keeping some of the children quiet, stopping them from fighting and staying on the task she had set. It appeared to be a concern, which was more prevalent in mathematics lessons. Some of the children still had not adjusted their behaviour to the requirements of the classroom and school. Any activity, which was not tightly teacher controlled, and even some that were, was quickly disrupted by some of the class. Tiffany often spoke of the children not being able to 'handle' the freedom inherent in many of the tasks. Under the general issue of control were some more subtle issues. Tiffany had to work with the poor social behaviour of a few of the children as well as the lack of engagement of some of the children. Both aspects tested her control and management strategies. They added up to her fear of not being in control. There was possibly a lack of cultural awareness as a factor within the situation as most of the disruption and control problems came from children of Aboriginal descent. The discipline and control issues were particularly significant for Tiffany in mathematics lessons.

Much was done initially on socialising children into acceptable ways of behaving in a classroom. Early work used groups, and foundered on the lack of children's ability to work together and accept other people's ideas.

T: I think they like working on their own. I don't think they like working in groups. They sit in groups and do a lot of group work all the time, but the Year Threes, it's a very small bunch, there's a lot of fighting, there's like other social problems that they've got, and they just sort of can't work together. And because it's such a small group we can't, you know there's not much of a mix, like there's, especially with the boys, the boys just you know, they'll get on good for fifty seconds or they'll be actually punching each other (T3).

There was quite a competitive ethos among some of the children which also presented barriers to Tiffany's desired way of working.

T: They can't, no. They would rather —they want it to be known that they've come up with the idea themselves, they don't seem to work together, they don't talk much (T3).

For many children, mathematics in Tiffany's proposed way of working was not enjoyable, because of the poor behaviour of many of the other children.

T: We did this one where I had, I did an introduction to Venn Diagrams, we tried this on Monday and we had the hoops on the floor and then we put our cards in which ice cream we liked. And we then had to work out a way of showing, you know, I like chocolate but I don't like vanilla and we had to work at that. And they got that, they got it in about the first minute. But then they couldn't sit there, they couldn't do anything else because they were chucking things around and that's behaviour as well, but I've noticed that with all these sort of activities, they just can't handle it yet. And they've done a lot of them really since the beginning of term. Not necessarily maths but, you know, science and language. ....they've actually said, we don't like this. And I think, gee, you know, this is supposed to be fun, because I enjoyed it. But they don't like it (T3).

T: Yeah, because I would say that socialisation is the biggest thing that is preventing the other ways of working (T3).

Tiffany adopted her preferred teaching style, especially in the first two or three terms of her first year of teaching, to reduce the chances of misbehaviour and class control problems. She became very teacher directed in her approach. Children worked from worksheets and worked on their own when told to do so. She was very aware of what was happening in the classroom, and the potentially negative consequences of her decision, but felt that the short-term actions would be of benefit in the long term.

T: Sitting them down by themselves, not working in groups, basically they all did the same thing, which wasn't really catering for their

different abilities, but they all did the same thing, and the ones who could do it probably just finished early and I didn't really cater for extending them, pretty much just do this (T7).

As a consequence of the conversations about control another issue began to emerge, namely that these children, in Tiffany's opinion, were different from ordinary children. She suggested that some of these children could only learn in traditional ways.

T: ...and when compared to, I've had a sit down where we've had lists of sums, we've had, because we've learnt multiplication, and they loved it. They just loved doing it, and they'll do pages and pages of that. And they sat there ...and you know, they worked out their own things with their counters and paper. And it was amazing, they just seemed to like it, and they've actually told me that's what they prefer to do. And I thought, and it's really, I mean, the students that we have at this school, and I know they are different from students in the city as well. It was just, it was weird because we are sort of taught, you know at college, that you do all these open-ended things but it doesn't really work with my kids (T3).

Underlying the issue of children not liking to work in ways other than in a teacher-directed style, was a feeling from Tiffany that they were not learning from the use of games and activity-based tasks. This was possibly a situation where deep-seated beliefs about mathematics teaching were coming into conflict with what she had been led to believe. Possibly, deep down she did not think that active learning methods worked but a rote-learning approach does work. There may also have been a factor of a lack of pedagogical knowledge, in that Tiffany was not able to 'see' the learning or use the tasks in such a way as to develop learning.

T: They can't, yeah, and then I don't really see them, I don't have any evidence they're actually learning anything from it, like it's good to do, I've tried a few number recognition games and stuff but it really, I don't see any concrete evidence that they've learnt anything from it.

And so I find that the only way that these kids seem to learn is if you sit down and you know, you just do the straight kind of work, do you know, do you understand that kind of thing. And that's where I mean I'm coming from, because like we were taught you know to try to make it interesting and concrete things but really these kids seem to just, they just don't seem to be learning at this stage. These kids just these kids. I'm not saying all kids (T1).

Another illustration shown below, was where Tiffany's possible lack of pedagogical knowledge was apparent. Her inexperience at connecting activities to mathematics and developing the mathematics within tasks was highlighted. More discussion related to pedagogical knowledge will occur later in this section.

T: Well sort of. I don't know, sometimes I think more games and then I think, yeah, but as long as they are going to get the message across. Because I like need, these kids really do need the sit down and like for spelling, like with the new *First Steps* and things, it says all these you know, spelling bingo. Well that's fine, but these kids actually do need to sit down and learn it, rote learn it. Because that still does work for most of them (T2).

Gradually, as the first year progressed, and as Tiffany gained more experience of controlling and managing the class, there were glimmers of success from working in ways other than the traditional, teacher-telling method. The role of reflection and the professional development model with 'fellow worker' support in this change of practice will be discussed under Research Question Three of this chapter.

Initially she found success with some of the children but then not until the end of Term Two.

T: Some can do it. The girls, I've found, not being sexist but the girls I've found can do it (T3).



T: See I find it's only particular groups, and the Year Twos can do, are actually quite good, I would say overall. They're probably better at working as a group than the Year Threes are. It's just certain individuals within the Year Three group that are making it difficult (T3).

The blanket argument that all children could not do other than traditional worksheet mathematics began to break down with reflection on what was actually happening and what individual children were able to do. Late in Term Two, Tiffany was more familiar with each child and their abilities, and as she became more familiar with the children's abilities she was prepared to try again other pedagogical practices. By the end of the first year of teaching, the behaviour problems of the children became less of a factor in Tiffany's pedagogical practice. This was because she was better able to cope with it and still focus on the mathematics she wished to teach. She had developed strategies to manage behaviour more effectively and also worried about it a little less.

T: Yes and there are behavioural problems, but I think I learnt to deal with it better, or differently, so that I actually get through it [mathematics lesson] now and actually teach something, whereas, before that was my major focus, so everything I did was just sort of not letting the kids get wild (T7).

Thus, from Tiffany's perspective in her beginning teaching year, the children in her class were a major factor influencing what she did in mathematics and how she actually taught mathematics to them. At first, their behaviour or the poor social behaviour of some of the children stopped Tiffany from working in ways she had learned during her teacher education course or had heard from other sources. The poor behaviour forced her to adopt traditional procedures. However, as Tiffany noticed some children having success with aspects of other teaching methods, her practice began to change and she adopted a less teacher-centred style. The children were a constraining factor, at one point in the year but later, they became catalysts for the adoption of other teaching methods.

## The present school context

From the literature on the influences on beginning teachers and teachers in general, for example, Mousley and Clements (1990), it appeared that the school helped to shape what actually happened in the classroom in powerful ways. This section will discuss the influence of the school on Tiffany's pedagogical practice. The 'school' is used to encompass her school experience as a pupil, and her school experience as part of her teacher education course. In addition, most importantly, the school context in which she worked for her first year of teaching was an influence.

As was the case of Stephanie in the previous chapter, Tiffany felt that she had been good at mathematics in her primary and secondary school.

T: No, because I've always been good at maths, but it's different when you come to teach it. I couldn't just assume, I don't even remember how I was taught maths when I was in primary school, all I just knew, I've just known that I've always been able to do it. ...all you know is that you either know it or you don't, you don't really recall how you learnt it (T7).

From the evidence of a single statement related to her experience as a school pupil and from all the interview transcripts, journal entries and observations of practice, it appeared that there was little or no overt influence of her schooldays on her present classroom practice in mathematics. There was little memory of what happened and possibly, therefore, no deliberate role modelling in her practice. It should be noted, however, that she saw mathematics as something "you either know or you don't," which may indicate a belief that mathematics, for her, is about mastery through rote memorisation as it was also "something you forgot very easily".

School experience, in the form of the non-ATP part of her teacher education course, has had very little explicit effect on Tiffany's teaching.

T: That was a Year two. I'm trying to think ...Well obviously she didn't influence me at all, because I can't remember what she did, so

I think it was, I mean I couldn't recall doing any concrete work, I remember she had her desks in rows, and she talked from the board, so when I did maths I probably did it in the same way (T6).

The school experience, as a teacher, had taken place in the previous year but apart from the longer, final Assistant Teacher Programme (ATP), little was remembered from the early classrooms and teachers. The final ATP experience had some observable influence on Tiffany, in the sense that she could recall some of the things that happened in the classroom. Tiffany talked about the teacher in her ATP classroom using a lot of hands-on things and, as part of her experience Tiffany undertook similar activities and adopted a similar style.

T: Her class were very bright Year ones, very well behaved Year ones, so they did a lot of hands-on things, they did a lot of things with counters, do little sums and then record them some way, on a sheet, so they did a lot of hands-on stuff. When I did maths with them I did the same thing, you do the same as what's around you (T6).

At one point in the year, she reflected back to what had happened in her ATP class and thought about doing something similar with her class.

T: Maybe I could set up a shop situation as well. The school I was at last year for ATP had a shop, they all had money. They actually set up a shop, I mean that's putting it into, that's about as real as it gets (T3).

This experience may also have been one of the influences on her beliefs about teaching, as Tiffany often referred to the need for concrete experiences and a hands-on approach to teaching. Throughout the interviews, Tiffany talked about trying to incorporate hands-on activities as a major teaching style. She was, however, frustrated in this by the disruptive behaviour of the children. She drew a comparison between the ATP class and her own first class as a teacher, and noted that the ATP children were "very bright ... and well

behaved”, unlike her own class. With her own class, she believed that this style of teaching was not possible.

When asked to consider the influences on her teaching before she started at her first school, Tiffany suggested that she couldn’t remember much.

T: So before I started teaching? Well the only other experience was at uni ... and I can’t ever recall much from uni (T6).

She did have an impression of what happened on her teacher education course and the messages that were coming from it.

T: ...because we’re sort of taught, you know at college, that you do all these open-ended things but it doesn’t work with my kids, I don’t think (T3).

T: And that’s where I’m coming from, because we were taught you know, to try to make it interesting and concrete things, but really these kids seem to just ... (T1).

Teacher education courses were for other children; it might work with them but not for my children, appeared to be the message that Tiffany was giving. It should be noted, however, that both these comments were made early in Tiffany’s first year of teaching when the issue of class control was a high priority for her.

The school in which Tiffany found herself for her first year of teaching exerted influences over her actual teaching. These influences were generally of an implicit rather than explicit nature. Tiffany was not aware of any expectations from the school or the Principal related to mathematics. She was not told what to teach, how to teach it or what the children should achieve. No mention was given of any school policies related to mathematics teaching in the school, which might have impacted on her mathematics practice.

T: Expectations? We are moving into the Student Outcome Statements. I think that's going to be a big expectation across the board in a few curriculum areas ...I can't really feel that there are any major expectations as far as you like, it's not well if these kids don't know this by this time then you know you'll be out of a job. I haven't felt any (T1).

The influence of the school and its context on Tiffany's pedagogy was more implicit and subtle in nature. Some influence was almost accidental. The latter point was best seen from Tiffany's comment related to trying to manage and control the children.

T: Yeah, three terms [to control the children] because like in the different terms, there's the sports carnival, there's lots of different things happening through the year that you've got to put up with as well, so you may have just got them under control when sports day comes up, or, and then they're high on it for a week ...(T7).

Tiffany started to establish calmness, routines and procedures for her class so that she could actually teach mathematics, rather than be constantly correcting misbehaviour. Her struggle to maintain control and, with this control move to other forms of teaching mathematics than a traditional, worksheet format, was often, inadvertently, undermined by decisions made at the school level.

Other school decisions, such as giving her a split year class, possibly unavoidable due to the school roll, made her initial job more difficult and complex and generally forced her to a traditional style of teaching in order to survive. School decisions did work in her favour because she had a school support system whereby a whole year group of children was taken from her classroom at various times during the week. This left her with only one year group of children to teach. Thus, some of the difficulties associated with a large class and a large range of abilities across two year groups were alleviated. The decision to support her by taking out some children was a school decision available to everyone and not given to support the beginning teacher in particular.

T: It's very hard for me to do maths because I don't do maths at the same time ...because I have the Year Twos taken out for language and I have the Year Threes so that's a good time for me to do just Year Threes. So I'm finding it really hard to, it's really hard to split, being a split class to do anything at once ...(T3).

Further school support for mathematics teaching came in the form of the lower school, joint mathematics group.

T: We have group maths where we ...we combine maths and dance which is an odd combination to combine junior primary 1/2/3. We have multi-age grouping and we do space and measurement down in the library which is really interesting. It's really good (T1).

T: ...our library teacher comes up with lot of ideas for maths ...and I think the ideas she's had and the way she's approached it and I've listened to her take a little group, like next to her, so she's influenced me (T6).

T: Well you see we've got seven teachers down there, so I'm down there with a small group, our aide's down there, then the music teacher's down there then ...so it's pretty much, it's well controlled, the materials are in the middle of each group, they're already set out ...She doesn't set it up, it's all done beforehand (T6).

T: ...see they've [the children] done this for so many years ...so they know what to do when they're down there, they know what it's going to be, I don't know whether it feels different in the classroom or ...but it comes down to the fact that there's more teachers down there to deal with it [misbehaviour] whereas there's one and 34 and that's the biggest thing (T6).

While the experience was useful for Tiffany, in that she saw her children taking part in mathematics activities using materials, she found it somewhat unrealistic, as there were more than enough adults to control the children. This was not the case in her classroom as here it was usually her and thirty-four children.

There did not appear to be any discussion of what was happening in the activities and why they were being done in that particular way. Tiffany did not talk of any interaction with the organising teacher about how such methods might be used in her classroom with her class. Thus, while Tiffany and her class attended these sessions, the ideas were not adopted in her classroom, especially in Terms one and two.

Tiffany also had the help of an aide who would be with her in her classroom at times during the week and would, at other times, ‘take out’ individuals or small groups of children. This should have provided Tiffany with classroom support. It might have allowed her to manage the children more easily and thus, undertake some of the more open or group activities she wished to use. In reality, however, it did not work in this way due to circumstances within the school.

T: I’ve got a teacher who comes in somewhat irregularly. It’s supposed to be regular but it’s haphazard. He takes a particular child who’s got social problems out, which makes it a lot easier because he can’t socialise at all. I have some aides that come in at various times to take different ones out. But still, even with those taken out, I’m usually left with maybe eight but six out of those eight are difficult (T3).

T: It’s just the time, because I don’t have as much aide time as before, so I’ve got 34 kids to keep busy ...

L: So let me get this straight. You’ve got more kids but less aide time?

T: Less aide time is not through lack of funding or anything, my aide's an Aboriginal Worker, so any Aboriginal problem, she's got to deal with the lot.

L: So in theory you have more time but in practice you don't.

T: Well in theory I have the same time, not more, but in practice ...(T6).

Tiffany suggested that other teachers were willing to support and offer thoughts and advice on classroom practice but their influence on her pedagogical practice seemed limited. As with Stephanie in the previous chapter, Tiffany did not ask for help even when it would have been useful to do so. She generally felt that she would be intruding, as everyone was very busy and she did not wish to add to their burdens. There did not seem to have been the fear that a request for advice or help would be construed as weakness and incompetence as is often the case with student and beginning teachers.

T: They were very helpful, but a lot of it you had to ask for. Because a lot of people are so busy doing their own thing. I did ask for different things ...because of the language and literacy focus, I think that was the main thing (T7).

T: They made me feel very welcome and I know I can go and talk to them about any problems I have. They tell me basically everything. They told me, you know, how the school's run and how they do things and they always pop in and out to see if I need a hand with things. Very supportive (T1).

They were supportive with regard to the day to day running of the school but detailed discussion and advice on handling the class and developing effective mathematics practice seemed limited. The focus of the school was on language and literacy, which left little time for developing mathematics teaching.



The real support that Tiffany felt she needed, planning with the Year 1/2 teacher and help with organising and controlling the class at the beginning of the year was not available. Therefore, she struggled on. Support from other teachers within the school was not generally a factor in influencing her mathematics practice in the classroom.

Tiffany often commented about wanting to work in a hands-on way with the children. She wished to use materials and manipulatives in her teaching. In most cases where she wished to do this, the school had equipment to support such a style of teaching.

T: Well we've got, I mean they've got MAB blocks, we've got other little blocks, we've got Unifix cubes, we've used sticks, counters, paint brushes at one stage ...(T3).

She felt that she would need more equipment, especially in the early terms of her teaching, possibly because she was teaching all of the children at the same time and needed enough equipment for all the children. She also talked about different resources to support her ideas.

T: Lack of resources, yeah. We've got a few but I sort of think, I sort of think well if only I had this, this resource or these I could probably do a bit more (T1).

T: Well I put in for maths blocks [MAB] and we're supposed to be getting them, the ones they've got, they've only got like 3 sets. ...the calculators are quite old, and we don't have enough of them, and we don't have a set (T6).

Calculators were lacking, so even if Tiffany wanted to use them, such a change in classroom and school practice would have been difficult. Limited resources in the school would have been a factor in determining Tiffany's pedagogical practice, if she had made a decision to work in that way. The children acted in a constraining way by their poor behaviour on her practice, however, and she rarely had to make such a decision.

School, in a general way, acted as an influential factor in Tiffany's mathematics practice. In terms of the school context for her beginning teaching year, these factors were mainly incidental and accidental rather than explicit and intrusive.

## Pedagogical knowledge

One might expect that with such a short teacher education course and restricted time in the classroom situation, that Tiffany's pedagogical knowledge for teaching mathematics would be limited. There were many aspects of teaching knowledge that had to be developed at a later stage, as not everything could be covered during the course.

Thus, one of the factors that caused a narrow or restricted teaching approach might be a lack of knowledge of other ways in which to work. Certainly, Tiffany was always looking for other ways to do things, usually at the level of mathematical activity rather than at the larger teaching strategy level.

T: ...that's what I wanted [from the discussions], just different ways of doing the same thing (T2).

Tiffany's classroom was set up with tables placed together in small clusters to form a focus for children working together. As discussed in an earlier section of this chapter, many children were unable to work effectively in these situations. To overcome the problem Tiffany used a whole class teaching approach, with individualised work at the grouped tables. The children were sitting in groups, but were actually working on their own rather than co-operating with peers. Tiffany wanted to use co-operative work with the children but it took her almost three terms to socialise most of the children into this style of teaching and learning. She had limited experience and knowledge of how to work with children in groups, but the overriding factor of children's poor behaviour meant that she could not put this into operation immediately with her class. A factor might also have been that while Tiffany was aware that she should be working with children in groups, she did not actually know how to organise and manage it in the classroom. Her experience of seeing such a system in operation was limited to a small aspect of her school experience. In school, she had mainly seen a whole class teaching style.

While she was willing to try activities such as game playing, to add variety to her pedagogical practice, she found it difficult to analyse what was happening and, especially, what children were learning as a result of playing mathematical games.

T: ...What I do is I get so far, but then I don't feel as though it's rounded off. Like yes, we do a game, and I read all the things and we talk about them and they say, but I just, I still, I don't know whether it's me but I've still got that thing in my mind that I don't know if these kids have learnt it. Because I mean, we just talk about it. I mean I know you don't have to record everything, you don't have to always have things written down. But I just seem, for me I feel unfulfilled (T3).

T: I don't have evidence that they're actually learning anything from it, like it's good to do. I've tried a few number recognition games and stuff but it really, I don't really see any concrete evidence that they have learnt anything from it. And so I find that the only way that these kids seem to learn is if you sit down and you know you just you just do straight kind of work ...(T1).

Tiffany's lack of pedagogical knowledge meant that she was not able to connect and identify the mathematics contained in games. In addition, she could not see how they could be used in a variety of ways to enliven mathematics learning for the children in her classroom. Games, for her, were used for children to practice some aspect of mathematics they had already learned in another way. The idea that games could be used as a teaching vehicle had not occurred to her.

T: ...I use games for practice rather than [teaching], but then it is motivating (T7).

Tiffany's limited pedagogical knowledge was one of the factors that resulted in a narrow range of assessment practices. Other factors such as the limited ability of the children in reading as discussed earlier added to the complexity of the situation. Her assessment was

mainly pencil and paper testing of the section of mathematics and its procedures, taught in the previous couple of weeks.

L: And the tests you've done, what sort of tests are they? Sort of paper and pencil?

T: Yeah, paper and pencil (T1).

T: Yeah, I've done a few tests, we've done just basically, I've talked to them and taken some notes and observations I've just recorded.

L: But talked, it's sort of an interview?

T: Informally, yeah, just like one-to-one or groups like just to see like a common starting point, what most kids know, what most kids don't know. I've talked to their past teachers as well (T2).

She was able to begin to incorporate other methods as the year progressed and as she became more confident. As with Stephanie, one of her concerns was to know 'where the children were at,' in their mathematical knowledge. She began to use observation and talked about using checklists of mathematical behaviours.

T: Well I guess there are tests not using paper and pencil but using like a concrete material sort of test. But they'd be really difficult to do unless you're having one-to-one. Yeah, I guess you could use materials instead of - actually they would be better, thinking about it, because a lot of my kids can't read. Well they can read but reading the question is half the battle and that's not what I'm testing. I'm actually testing concepts so that could actually be better (T2).

Portfolios were incorporated into the assessment profile used by Tiffany after Term three. This initiative came from a combination of her knowledge from her teacher education course, work within the school on language teaching and discussions with the researcher. By December, Tiffany was seeing assessment in a wider sense than just paper and pencil.

Now, she incorporated a small range of techniques and strategies. She still, however, regarded assessment as mainly written and separate from the teaching. It was a summative strategy: teaching followed by assessment. She did not integrate assessment along with teaching in a more formative way, where the results were used to inform the next piece of work with children.

From early in the year and during most of the interviews Tiffany mentioned the need for ‘hands-on’ teaching and concrete materials. She had a strong notion that using manipulatives was important for children’s learning.

T: That was a good success, I’m trying to think how I did it now, I used a sheet that had tens and ones on it, and of course we used MABs, and we used, you know, two tens and three ones, or whatever, that was a success actually. They all seemed to manage to get how to do that (T6).

Throughout the year she persevered to incorporate manipulative materials into the teaching style she adopted with the children. Even with the difficulties she faced with many of the children’s poor behaviour, she continued to try to use concrete materials and a ‘hands-on’, approach in her pedagogical practice. One can only speculate as to the source of this strong belief in the importance of concrete materials and a ‘hands-on’ style of teaching, as there is no evidence contained in the transcripts from the interviews. Tiffany’s teacher education course was very active and used many concrete materials to illustrate teaching points, so her interest in this teaching strategy may have come from there.

Tiffany used blackline masters and worksheets in her teaching but did not work systematically through a textbook.

T: ...well I don’t really use many textbooks, ..I don’t really use textbooks when I’m teaching, I mean you use the worksheets but you adapt them so I never actually say like turn to page 4 of the textbook, I don’t really use textbooks in that way (T7).

The influence of textbooks and printed material on her pedagogical practice will be discussed further in a later part of this section, which considers other sources as a factor in her teaching.

## Professional development

Professional development was not a real factor on pedagogical practice in Tiffany's first year of teaching. Being in a more isolated situation than, for example, Stephanie, it was much more difficult for her to take advantage of non school-based professional development opportunities. These tended to be concentrated in the main metropolitan area, over a hundred kilometres away.

The emphasis within the school during her first year of teaching was with science and language. This took up all school development time. There had been no contact by the Education Department apart from an early orientation meeting in Perth. There may have been some influence from her professional development discussions in language. This was at an implicit level, because Tiffany generally saw language and mathematics teaching as separate entities.

L: District Superintendent?

T: She's been once. I met her actually on an open day, we had a graduate day at Bentley in February sometime, January sometime and I met her then. So that was one thing they did provide but I don't know how beneficial it was for me (T1).

Tiffany was aware of the regional Resource Centre. She had taken the initiative to visit it for resources for her classroom.

T: No. The only thing, I mean I had contact with the resources centre and that's because I had gone to see them. Because I wanted to get things. It hasn't been anything like, like no visits from them [the Education Department consultants] saying this is where we are and this is what we do, nothing like that. It was, I had to find out where they were (T1).

By the end of the year, her only memory of anything from professional development and mathematics was a meeting organised by the researcher for this project.

T: I went to some PD or something and they said, no that was you, yeah, when we went to that thing, when you said teaching maths should be like teaching language, that thing we read, wasn't it, that's stuck in my head (T7).

Professional development and pedagogical support for mathematics teaching, or teaching for any subject for that matter, was not forthcoming from the Education Department and was not a positive influence on her mathematics teaching in the first year.

## The researcher

As with professional development, this was not really a factor in Tiffany's pedagogical practice. A much fuller analysis of the influence of the researcher will be undertaken in the section on Research Question 3, which considers the professional development model as a whole.

The researcher was also the lecturer for Tiffany's mathematics education course and, has already been noted earlier in this section, Tiffany remembers very little of her course. The main influence of the researcher in this context was to remind Tiffany of aspects of mathematical pedagogy that she knew about from her teacher education course and discuss how these might be used in the classroom. There is little evidence that this was a factor in her pedagogical practice. Her belief in the use of manipulatives and a 'hands-on'

approach may have come from this source, but as noted earlier, there is no direct evidence to support this suggestion.

### Time constraints

Time, or lack of enough of it, was a major factor for Stephanie in her teaching. This did not appear to be the case for Tiffany, who only mentioned it on a few occasions.

Certainly, Tiffany found it “difficult to get everything done” and “to fit in everything”, particularly as the children worked more slowly than she anticipated.

T: It’s hard to get everything done during the week that I plan to, especially maths I must say. Maths is difficult to do with this class because I’ve got a split 2/3 and I find the abilities range from early Year One to Year Four sort of ability. And I find it hard to get through the maths, it takes, it’s very slow, progress is very slow (T1).

Factors from within the school, such as swimming weeks and sports carnivals took away a considerable amount of time and made Tiffany even more conscious of the need to get things done. She believed that her first term had been “a waste of time” and that this added to the pressure to move quicker through the material in the remainder of the year. She did not consider using these events as part of her mathematics teaching as a theme or integrated project.

Time became a factor in the context of the teacher aide and the amount of time she was able to spend with Tiffany and her class. As the year progressed Tiffany acquired more children in her class and due to other factors less, in practice, teacher aide time.

T: Yeah, I think I probably could do, it’s just the time, because I don’t have as much aide time as before, so I’ve got 34 kids to keep busy, and the only time I’ve got to do maths with the Year Twos is when the Year Threes are in the room, and that’s really hard, if I haven’t got an aide to keep them all under control (T6).



She was being forced into a situation of “keeping kids busy” as she did not have an aide to help with the control issues. She was therefore less able and less inclined to move from a traditional teaching style with its control, to one that she felt might lessen her control of the children’s behaviour.

## Other sources

The school used a textbook series as the basis for its mathematics work and Tiffany followed this lead. As with many teachers she was interested in the book for the ideas and having the material ready prepared so that she did not have to write it herself.

T: ...the *Maths Today Series* book is pretty good, that’s the series we use, so sort of to get the ideas for things to do (T6).

T: Based, well we use the *Maths Today Series* book. They’ve been using that so I’ve based some of the tests, there’s actually a test bank that you can use but I don’t use that. I based, they’re similar questions but I also, they’re too, I know they’re too hard for the kids so I actually make them up, I use my own questions (T2).

As she noted, she based her work around the textbook series but tended to adapt the pages and the test material to suit her children’s ability. She offered the same philosophy for the use of worksheets and commercially produced black line masters.

T: I’ve got a good fraction worksheet book. I went to Woolridge’s, had a look because I thought, how do I teach fractions, I didn’t have any idea, and I thought well I’ll have a look at how they, because I didn’t know how to explain it, in simple terms, for junior primary, and that book, lots of worksheets, the worksheets are good, but the book actually had it written up in simple language, ...It’s got the activities progressively, the way they explained things was really simple, fractions is quite hard to explain (T6).

There seems to be a feeling of being unsure what to do and how to do it so Tiffany is looking to any source she can think of to gain some insight into what should be happening. Possibly she is trying to find the 'right way' to teach mathematics? It should be noted that her teacher education course addressed the issue of teaching fractions. It gave a development for teaching fractions and a number of teaching ideas and models. This was further evidence that the teacher education course had little influence on Tiffany's pedagogical practice. Following the example of the other Year Two classroom was a possibility for finding out how to teach fractions. The teacher had been teaching for some years and maybe had solved the problems and the confusion faced by Tiffany.

T: And I mean I sort of look at what the other Year Two class was doing, especially with the  $\frac{2}{3}$  I didn't know, I didn't know where they should be at, I didn't know what level they should be at, so I sort of ...(T7).

She did not expect the Education Department to have any role to play in what happened to her or in her classroom.

T: I don't see them having a role in actually once you are in the classroom, I sort of think they just try and get you there, and I wouldn't have wanted their help ...I just think that once you are in a school then you are in that school ...and you can't have someone from the Education Department who doesn't know about your school and doesn't know about your children and doesn't know about everything else, I wouldn't think them giving you advice would be terribly applicable. I suppose I would rather take advice from the Principal or other staff (T7).

By the end of the first year, Tiffany had developed some confidence in her ability to teach mathematics and had taken quite an independent stance about the influence of others from the outside. She appeared to think that her situation was different and that no one else, not even theory and research can know what might work.

Other factors from the list shown in the research question, for example mathematical content knowledge, teacher education course and her beliefs about mathematics, and mathematics teaching and learning appeared to have little explicit influence on her classroom practice.

## Summary

In summary, it could be said that the major influence on Tiffany's pedagogical practice in mathematics teaching was the children in her classroom and her relationship with them. In many ways, they acted as a limiting factor on what she was prepared to try and how successful she was when she did try to incorporate a less traditional teaching style. Tiffany continued to experiment with more open styles of teaching and some of the children. It was on many of these occasions that she experienced success and positive results. In this sense, the children acted as a positive agent on her practice, as she saw that there was value in working in non-traditional ways. The school also influenced her practice as it at times it inadvertently caused her to work in more teacher-directed ways to control the children who were excited by such things as sports day. At other times it helped her to overcome some of her difficulties with control as the aide system removed some of her class and allowed her to manage more easily the less troublesome children that remained. With these children she felt more able to try different teaching styles. From the positive experiences she gained in working this way she was more inclined to repeat the teaching style with the full class later in the year. Another factor influencing her teaching style was her limited knowledge of teaching in general and teaching mathematics in particular. She was often not aware of the connections of less teacher-directed activities to mathematics learning. As some things to her were not obviously to do with mathematics she continued with a teacher-directed, procedural style, as she could see the connections to mathematics.

## Research Question 2

*To what extent do the following factors influence the pedagogical beliefs of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's reactions and behaviour;
- the beginning teacher's education;
- professional development;
- the researcher; and
- other sources.

Teacher beliefs about mathematics, mathematics teaching and mathematics learning may play an important part in what actually happens in a classroom (See for example, Thompson, 1992). This section will consider the evidence to identify beliefs held by Tiffany, how they may have been influenced by her experience as a beginning teacher and how they have impacted on her classroom practice in mathematics teaching. As was discussed in the previous section on Research Question One, the main factor impinging on her classroom practice was the influence of the children.

### Children's reactions and behaviour

Tiffany's beliefs about children were closely aligned with her beliefs about mathematics teaching. Another interesting feature, and it was the same belief identified with Stephanie, was that she believed somehow these children were different from other children, normal children, if you like. While Tiffany spoke of the idea that normal children needed to work in certain ways, she appeared to believe that the children in her class needed to work in different ways because of their ability.

T: Well, that's fine, but these kids actually do need to sit down and learn it, rote learn it. Because that still does work for most of them. So I want to get a balance there, like I want to do some games for those kids who can start to use the, use the maths, and some kids need to basically still sit down and learn it (T2).

Thus, Tiffany believed that these children needed to learn by sitting down, being told what to do and how to do it, and then remembering that method. One might suggest that Tiffany did not actually hold this belief about all children. She appeared to believe that capable and well-behaved children could work in other ways but less controlled children were different. The children in her classroom confirmed and reinforced her thoughts. She stated that the children are not ready for anything else other than being told what to do and then practising it until it was mastered.

T: It was, it's all controlled. It's not sort of saying here's the things go and do it. I demonstrate on the board, I think we did the same thing about ten times, before I let them go and do it. I think that was the problem I found, some of them just sit there, they just don't know, so you've got to actually say it four or five times, before they really get it. I think they were just saying yeah I know and going off and then causing the behaviour problem (T6).

What also started to emerge was a conflict for Tiffany. A conflict between her underlying belief about these children and mathematics and the messages she received from her teacher education course and her reading about teaching. This dilemma was between telling the children the facts and methods and using other strategies, such as game playing and concrete materials to help them learn. A certain amount of confusion was apparent and she was not sure what to believe. She had heard the theory and recommended strategies but the evidence of practice and context seemed stronger and initially was a factor influencing her belief about teaching mathematics.

Part of the difficulty that Tiffany faced in trying to reconcile these conflicts came from the reaction of the children. To a certain extent, their behaviour and reaction to her

teaching style confirmed a possible underlying belief that children do not really learn using these modern methods.

T: I think they like working on their own. I don't think they like working as groups. They sit in groups and they do a lot of group work all the time but my Year Threes, it's a very small bunch, there's a lot of fighting, there's like other social problems that they've got which means that they, a lot of them don't like to work together, and they just sort of can't work together (T3).

The children also confirmed for her that group work and work, which used other than a traditional whole class approach was not enjoyable for them. The children preferred learning mathematics as individuals. They brought a social constraint as an influence on her beliefs about mathematics teaching.

T: They've actually said, we don't like this. And I think, gee this is supposed to be fun, because I enjoyed it. But they didn't like it (T3).

There appeared to be this internal conflict happening throughout the year. The experiences and vague memories from Tiffany's university teacher education course presented a picture of how one might teach. Early attempts at adopting this style, however, did not work well. A combination of poorly remembered strategies and pedagogical inexperience of effective ways to implement this teaching style worked against immediate classroom success. Tiffany was still to be convinced that modern approaches actually teach the children anything.

T: ...What I do is I get so far, but then I don't feel as though it's rounded off. Like yes, we do a game, and I read all the things and we talk about them and they say, but I just, I still, I don't know whether it's me but I've still got that thing in my mind that I don't know if these kids have learnt it. Because I mean, we just talk about it. I mean I know you don't have to record everything, you don't have to always

have things written down. But I just seem, for me I feel unfulfilled (T3).

The doubts about the validity of non-traditional methods of teaching were still in her thoughts at the end of her first year of teaching. This was even after she had had a certain amount of success with the children and more modern methods. Her beliefs were relatively strong. The newer methods still had to be seen to work consistently in her classroom to fully convince her that they were effective in teaching the children mathematics.

T: ...but then all the little activities that *First Steps* teachers do, like going through the newspapers and cut all this out, I mean that's fine, but they don't really learn, they just think it's great, going through newspapers, but they don't actually, with all these activities you do, they don't learn. They remember them for the test at the end of the week or whatever, but then you test it three weeks later and they don't remember. It's sort of more, rote learning and sit here and read all of this and doing all of that (T6).

Tiffany did not believe that using calculators as a teaching aid would help these children learn. The belief was not really an issue early in her first year, as the school did not have any calculators for the children to use.

T: No, well that's the thing, we don't really have any, ...some kids have got them. I don't really like it at the moment, because I think these kids, once I give them the calculator, I don't know (T3).

Later in the year, with the aid of some borrowed calculators, she found that the children reacted positively to them. She began, because of positive experiences, to see some worth in their use.

For much of the year Tiffany espoused and adopted a more traditional approach to teaching—procedures were demonstrated, children reproduced them and through practice, they remembered them for the test. The image of the mathematics teacher as 'the

teller of how to do things' was very strong. Later she began to believe that there might be different ways to teach mathematics. This did not happen until she had more of the children under control and was confident enough to allow the children a little more freedom in their thinking and methods. With the changing of teaching strategy, there came a modicum of success and with this success, Tiffany began to trust the worth of other teaching methods. Her positive experiences began to effect her attitudes and beliefs about mathematics teaching.

T: You know what I think it is, I think it is because I've got in my mind what maths should be. I'm standing there and they're all sitting there, whereas when they've got like, this is the number, and I'm off doing work with the Year Twos, so they're actually learning by themselves, and I think Oh, that's just a time filler, it's not a maths lesson. But it really is. But I've got the view that I should be up there teaching all the time I think (T7).

T: Yeah, telling. I think maybe I got into this habit of I've got to tell them, otherwise I'm not teaching them maths. I mean I don't do it for language. Well to a certain extent you have to, but I don't tell them they've got to ...I've sort of got in my mind that maths is me and I've got to tell them. There you go (T7).

Tiffany appeared to have a belief that she has to do the work, the teaching part. She began to realise, however, that it was the children, who had to do the work, the learning part. Her job then became to find ways to allow them to learn.

At the end of the first year of teaching, Tiffany was thinking much more of the teacher as a coach, rather than a director. She now believed that the children needed guidance to obtain their best performance. She still appeared to believe that there was a performance to be refined, and thus, a correct way to do mathematics.

T: Well I think I should be a coach, sort of like, because they need the guidance then, they need, they can't be totally left alone to find things



out, they need some sort of encouragement and coach ...you're not sort of directing it, I don't think you should be telling them all of the time, get them on the field and they do their own thing (T7).

T: Yeah, but you're there to guide them and refine the skills like if they go astray you've got to pull them back, or they could get the wrong answer and everything. I mean I think a coach (T7).

Tiffany was concerned about new methods and her belief in them. Her belief in them was fragile and their effectiveness was unproven. Further positive results were needed to make her belief in non-traditional pedagogy stronger.

### The beginning teacher's education

This appeared not to have been a major factor in influencing her beliefs about mathematics. She had, as far as she could remember, pleasant experiences as a child with mathematics. Mathematics learning came easily to her and from this she had a favourable attitude to mathematics.

T: I've always been good at maths, but it's different when you come to teach it. I couldn't just assume, I don't even remember how I was taught mathematics when I was in primary school, all I just knew, I've just known that I've always been able to do it, but I don't know how I learnt it (T7).

Tiffany appeared to believe in a natural or innate ability in learning mathematics. She was good at it, while others were poor at learning. Those children who were poor at learning, possibly as shown by the children in her class, needed teaching the correct way to do it.

### Summary

Tiffany gradually developed and changed her beliefs about mathematics teaching over the first year. This, it could be argued, was due to the positive experiences she had,

coupled with the time to reflect on those experiences. The positive experiences came from the reactions of the children to activities she undertook with them, that were of a non-traditional style. She has still to be convinced that the children learned any mathematics of importance. She believed, at the end of the first year, that non-traditional methods of teaching should be undertaken with some of her children.

It could be argued that her time as a pupil had established her initial beliefs, albeit in subliminal ways. In addition, her teacher education course had started to undermine these, as it exposed her to methods of teaching, other than those of a traditional approach. There was little evidence to suggest that other factors in the list for Research Question Two had any significant influence on her pedagogical beliefs.

### **Research Question 3**

*To what extent is a teacher empowerment model of professional development, with 'fellow worker' support, an effective way to help beginning teachers develop as professional teachers?*

A detailed discussion of the support model was presented in Chapter Three. This section will discuss the interaction of the professional development model and the beginning teacher, in this case, Tiffany. It will consider each of the fundamental features of the model, empowerment via options, reflection and experimentation by means of action research, and will evaluate their effectiveness in developing change and offering support for Tiffany. The first part discusses the options and teacher empowerment aspects of the model.

#### **The professional development support model**

The use of a style of interaction that offered the beginning teacher a series of options for action was a strong feature of the professional development model. In the case of Tiffany, it appeared to be useful both from a point of view of support, as well as in developing change. The underlying philosophy of the model, as was applied to Tiffany, was that it would address the concerns of the teacher and use the context of her classroom for its

suggestions. For Tiffany, the main concern, especially in the first part of the year, was one of control and managing behaviour within the classroom.

The following excerpts from the interviews with Tiffany illustrate how the options aspect of the model worked with her.

L: So sort of just socialising, a game playing thing. And you could look at it like that, let's look at the options. What options might we —so an adult is there to help with the socialising process, and a game or an activity which has a less of a competitive thing ...(T3).

Some of the options offered by the 'fellow worker' kept the aspect that Tiffany wanted, game playing, but looked at ways to continue it within the constraints of her classroom. Controlling the children was a major concern and had to be addressed, so that effective mathematics teaching could progress. Further options were discussed which would maintain and extend control, but at the same time incorporate more 'hands-on' work with the children.

L: But if it's an individualised thing, here's the task, you have to see, you have three counters you can place in the squares, what number can you make? So you're almost, you're very much in charge of them though and controlling the amount of time.

L: So you've got two minutes, can you make two different answers. And then they share back. And then maybe put it out again, what's the largest you can make? Try to make four more totals. So you've extended the task a little, and then again bring it back, so you're getting a different thing. What's the largest total people have found? How did you find twenty-four? Then maybe the sharing comes, and the next bit out is with the person next to you, put your lists together and see what you get between you. So this sort of in and then back out (T3).

Options for developing aspects of classroom socialisation were also offered by the 'fellow worker'. These were given as possible ways to achieve the working together goal but also for the children to complete some worthwhile mathematics at the same time. From these options, Tiffany could select the way she wished to progress with the class.

L: Maybe then, perhaps to pair work or to three work or even to combine their lists, how many ways can you get for this table? Maybe if you had the answers on a sheet and what they had to do was to supply how they found them. So they've got to check. So we need to work together and work as a team. You know your kids ...(T3).

L: Well I've got everything crossed. The sort of principles of short amount of time, you controlling how much time, you controlling when they are going to work together. You might have then, I'm just thinking about this, you might have then a class answer on your white board, trying to bring it back together. You might have then on your white board a class answer. So we are all trying to get this class answer. I don't know. That's the nice thing about this, you have a problem, you try something, you see what happens and you try again (T3).

As far as possible more than one way to try to solve the problem was discussed. The beginning teacher then had to select, or not, which option to try first with the children. In this situation, Tiffany made the decisions for the options that she felt suited her, the children and the context.

L: That's another option. Oh, and again just thinking around, we talked here about working with a partner to get some more [answers]. Maybe this is a chance. Now work with your Year Three buddy to see if you can get two more and put your lists together or whatever (T3).

L: So if you can then, you might want to isolate some for a while, but work with those children that will [work co-operatively], and those

kids that are not able to work in this way could do something else (T3).

Tiffany wanted to incorporate aspects of talk by the children into the activities. This was a way to help the children with the socialisation process. In addition, it was a way of preparing them for the writing that might be part of the activity.

L: Well I used to do this with you [as part of your teacher education course]. So you've got two minutes on your own to think about all the things you can tell your partner about twenty. Then you've got one minute to tell your friend everything you know about twenty. So that's verbal, I'm trying to get away from the written (T2).

There was also the underlying idea in the model that the conversations would remind Tiffany of things that she had experienced on her teacher education course. It also explored ways to use them with her children and their problems. A strength of having an experienced 'fellow worker' with a novice was that the 'old hand' could add in information that was possibly unknown to the novice.

L: Well there are a number of ways, you can actually use games to learn, you can use games as a motivation to learn and you can use games as a practice (T6).

A vital aspect in striving for change and development was to respond to the reflections and thoughts of the beginning teacher. The most productive way appeared to be to pick out the positive happening from a situation, even where the total situation had been negative. The positive aspect was then used to illustrate how further work in the classroom could be developed.

L: I'm now thinking around, pair work, from when I was with you before we had those timers, that seemed to be useful. If you have pairs, I don't know I'm making this up, turn the card over, it says two times four. What I have to do is to use the multi-link to show two

times four, put it together and give you the answer, and in the meantime, you're timing to see ...(T6).

All the time the idea was being returned to her classroom, her context and her children and was embedded in her problem, to give it a feeling of reality. Throughout the year, it was continually established that the responsibility for the direction of the project in her classroom lay with her.

L: ...is there anything you want to say, get your bit in first.

T: No, so I don't know if I've done it properly. Well I used your guidelines that you gave here.

L: Well there isn't, there isn't a properly.

T: There isn't a properly. Oh, that's OK then. I just jotted things down in note form.

L: Will it communicate, will I be able to understand the language?

T: Yeah, Oh, yeah.

L: That's OK then (T2).

Tiffany's reaction to the model, the options and reflection methods of working was positive and she said she found it useful for her teaching.

T: ...it's actually quite good because it makes me think about it as I'm writing, as I was writing one, I thought well then you could have done something different that you wouldn't have had that problem with. So it's actually quite good that I'm writing it down because it's forcing me to think about it again and as you're writing it down you're thinking of other things. So it's been good, that was a benefit of it (T2).

Some things, possible options were mentioned during the interviews, which were not put into action until much later. This was an acceptable part of the approach. Tiffany made the choice as to what she wished to use and when she wished to use it. At times, some of the options were beyond Tiffany's experience and her confidence, to put them into practice. For example, the suggestion about the class chart made in April was not used until the start of Term four in early October.

Part of the role of the 'fellow worker' was to act as a resource person. He had access to many more resources, mainly in the form of books and pamphlets, than Tiffany. He knew them well enough to identify and locate what was needed quickly. During the interviews, it became obvious that a certain book or teaching idea would be a possible option to try to help solve a particular problem. A note was made and the book was sent later by post.

L: What I'll do is I'll look them up when I get back and send you some copies. For an open task these are too hard ...(T3).

The success of this method was questionable, as sometimes the 'fellow worker' forgot to do the task straight away, so that when the book or papers did arrive with Tiffany, the optimum moment had lapsed. In addition, they arrived without the 'fellow worker' being there to explain exactly what they meant and how they might be used. In this situation, there was much less chance that they would be seen as a viable option and be incorporated into the mathematics teaching.

For Tiffany, the project and its style were useful. One of the ways in which she wanted to work with the 'fellow worker' was to do a joint teaching session. She referred to this as being a positive aspect, as it showed how more open ways of working could be successful with her children and their behaviour problems.

T: When you came into the lesson that was extremely helpful, and just doing this [talking to the fellow worker] is helpful as well, because I'm thinking about it and it keeps coming up in my mind, like every two months or whatever. You keep having a look at yourself and a look at what you do and assess yourself, so that's

good. I mean because you came into the lesson and watched, you didn't get a chance, but that was something that was good ...

L: I didn't actually tell you what to do. Well I could have come in and

T: No, you left me to it.

L: and said, what you had to do is this.

T: Yeah, exactly, and I would probably have thought, yeah, no. So that was good.

L: So that was helpful?

T: Oh, yeah! Because then, just the fact as well, because you said right what do you want me to do a lesson on, because then I could do what was applicable to my class, I got more out of that than you just coming in and doing anything, and I would have probably thought, yeah that's good but I'll never use it, or no that's not relevant now.

L: As I said what I'm trying to do, what the basis of this is, is that while I didn't tell you what to do, there were times I felt I was doing that.

T: No.

L: And what I tried to do was to find out what you wanted to talk about, and then try to look at the options, and then you made a selection.

T: Yeah, that was good, because it was, I mean when I think back on it. I didn't think oh no Len's told me what to do, I mean I needed some guidance because some things I just didn't really understand, that was fine so what you did was probably guided rather than not guided towards but given help (T7).



The approach adopted by the model for professional development and support appeared to be successful with Tiffany, as it attended to her problem at a time when attention was relevant. The non-judgemental and options style was appropriate as it allowed Tiffany to make choices, which she felt she could undertake at the time. Where she was not able to use the ideas, due to such things as her need to control the children's behaviour, she felt comfortable with her decision. The aspect of the support model, which encouraged her to reflect on her teaching, found favour with Tiffany. It is this part of the model that will be discussed in the next section.

## Encouraging teacher reflection

Reflection on action was a main part of the professional development model. The role of the 'fellow worker' was not only to act as a sounding board for the Tiffany, but also to encourage the teacher to reflect on her practice. In this way, it might be possible to set into action a technique which could be used at other times, in particular when the 'fellow worker' was no longer present. The technique of reflection-on-practice is often considered part of the job of a professional teacher. This section will describe how this aspect of the model worked with Tiffany.

The general style for the 'fellow worker' was gently to ask questions about incidents, to ask for clarification of the situation and so focus the teacher's thoughts on the happenings in her classroom.

L: Well if you want to try a bit more, let's try to, pick the eyes out of it if you like, and see ways in which it might go forward but little ways. Is there anyone, or more than one, or some people in the class who can actually cope with a small amount of it? (T3).

The power here was that thoughts were always grounded in the reality and immediacy of the teacher's classroom. Nothing was 'theoretical', in the sense that many teachers see responses given at general, professional development courses to be. Another aspect of the technique was to give the beginning teacher the opportunity to engage in reflection with the aid of a more experienced colleague, and so through practice, incorporate it into her

‘tools for teaching’. Generic questions for reflection were posed.

L: Are there other things that you’ve noticed as you were going along? (T3).

L: How might the Year Threes react to the fact that they are the teacher?

L: What do other teachers do about socialising? (T3)

Other methods included encouraging Tiffany to consider ways to solve the problem from the knowledge she already had, or from the things that were at hand. Early in the beginning year, statements and observations that Tiffany made were gently challenged, so that she began to base her comments and thoughts on the reality of what she saw and heard rather than on generalised myth of teaching.

L: So you say you think it’s boring when you’re teaching, What, I don’t know what boring means.

L: What do you mean problems? (T1).

At other times, the ‘fellow worker’, reported directly the beginning teacher’s words, often to confront her with her beliefs as she expressed them in the interview.

L: What you seem to be saying to me before, and my interpretation is, is that what you want is these kids to know things by rote (T6).

As has been noted, the professional development model was grounded in encouraging beginning teachers to reflect on their own practice and the idea that success and a positive experience (Ellerton & Clements, 1994) will impact on beliefs and so develop change. The literature on teaching practices noted that teacher beliefs impacted directly on pedagogical practice and the more positive the experience the more impact it would have in the classroom.

Particularly at the start of the teaching year, it was often difficult for the beginning teacher to see anything that was going well and was effective. Often all that was seen was a mass of failure and difficulties.

L: OK. Tell me about something that worked very well. I'm only going to let you have one, one go so you can't give me a whole list. So something that's been successful, particularly in mathematics (T1).

The role of the 'fellow worker' in this situation was especially important. It was to bring out the success of a situation for the teachers. At other times, it was necessary to identify the success or remind teachers of their past successes.

Another part of the training in reflecting was to help the beginning teacher see that it might be possible to resolve the particular problem in the classroom in more than one way. Hence, it might be possible to avoid an instant, unthinking response in favour of a more considered way forward.

L: What other things do you think are available? What other options are there? (T2).

L: Do you teach maths like you teach language?

T: No I don't, well ...

L: If you don't then how are they different? (T7).

At all times, the considerations and possible solutions were based on the context of the reality of Tiffany's classroom. How she responded to the technique employed by the 'fellow worker' is the subject of the next section.

## Teacher reflection

One important feature of the professional development model was to help the beginning teacher *reflect-on-action*. Eventually, as a result of the guided practice, she would be

able to do this on her own but also to be able to move more clearly to be able to *reflect-in-action*. This section will consider the evidence available to make a judgement about how effective this move has been.

Eventually, Tiffany came to know her children and their abilities more clearly and was able to analyse her pedagogical practice better.

T: They just need more realistic practice. I don't know exactly what I mean by that, but like, I guess not just a subject on a page is what I was meaning. They need experience at, you know, counting real things, in the room and outside, and like with those games, that was sort of a real thing, but they need more practice at that sort of stuff. Because they just, they sort of get lost, they can't apply the principles from there to the real world, sort of thing (T3).

She also started to develop options for solutions herself rather than relying on the 'fellow worker' to identify the options through the act of reflecting.

T: Maybe I could set up a shop situation as well? The school I was at last year for ATP had a shop. They all had money. They set up a shop, I mean that's putting it into, that's about as real as it gets (T3).

As the year progressed, Tiffany became more confident and practised at reflecting and thinking about what she had done and possibly why she had done it. Gradually, she began to connect her practice to the research literature and recommended practice in a thoughtful manner.

T: Yeah. It's definitely worth, that's a good idea, because I like the way that it caters for different levels, and I think it's manageable for them (T3).

Often there were surprises for her when she actually thought about what had happened. Some of the surprises confronted her beliefs, especially her beliefs about what it was possible for her children to do and achieve.

T: Okay an activity we've done? Okay, well the kids liked this so I guess it was successful. We had a dice game where we throw dice together. We start off the magic number, say it's 20, you roll the dice and you've got to take away that number from it. The kids seemed to really like that and they were very enthusiastic to do more, which was a real surprise to me. Some kids had problems doing that but they still like, enjoyed it (T1).

T: Yeah, I will. I'm going to, I intend to actually do it again with some different material. I think they can do it, I mean I said last time, they couldn't do it, but sometimes they can, it depends on who's in the group as well ...

T: Yes we've actually got help now in the morning so I've got four kids outside and they're the ones which really cause these problems so the others can do more concrete things (T6).

Gradually, Tiffany developed more confidence, and through talking and reflecting on what had happened and reasoning why it had happened in a particular way, she was more inclined to work in different ways with the children. These ways tended to be more in line with recommendations from official documents and research findings.

Reflection, in the form of her journal, was also a useful vehicle to enable her to take time to think about her teaching, to analyse what was happening and to identify possible reasons for the reactions. Finding time to write the journal was a difficulty, especially for the beginning teacher who spent most of her time thinking about how to survive for the next minute, rather than planning for a long term strategy.

T: No, no it's not, it's actually quite good because I actually, it makes me think about it and as I'm, like as I was writing one, I thought well then, you could have done something different that you wouldn't have had that problem with. So it's actually quite good that I'm writing it down, because it's forcing me to think about it again and as

you're writing it down you're thinking of other things. So actually it's been good, that was the benefit of it (T2).

The act of reflecting gave Tiffany a realisation of a way forward, and a way in which she could develop her teaching. She saw it as a way to escape the narrow mindset of procedural teaching that she had allowed herself to adopt in an attempt to overcome the behavioural problems of her children. Without this reflecting and its emphasis in the professional development model, she might have remained with the traditional teaching style.

T: I think you get stuck in a mindset. Like once you get into the practical teaching that way [traditional method], it's hard to get out of it. You know, like you are just thinking all the one way but if you start thinking this way [reflecting] then you can in fact, probably think of a million things to do.

T: Mmm, that's a good one. Because you could do, there's lots of possibilities with that.

T: That's a good idea. Yeah, it's actually good because my year Threes, I only have them like, I only have them in the classroom. And they're only 12 kids. So that's really good (T2).

As the year progressed, she became more adept at reflecting and thinking about her practice. She was able to see the successes she was having and use these positive experiences to move forward in her teaching. She was doing this now in a way almost independent of the 'fellow worker'.

T: I've done that the magic number one.

L: How did it go?

T: They did really good, I actually did every day a different magic number, some had only four sums, some had twenty-four sums, that was something. I sort of used that a little bit like a time filler ...(T7).

Not only had her practice changed, but her attitude and beliefs were also different. She was now able to see what had happened in her teaching as she reflected on events in the classroom. The act of reflecting, encouraged by the professional development model, was being used to refine the quality of her pedagogical practice.

### The action research model

All aspects of the professional development model under discussion were encapsulated in an action research cycle. The ideas of teacher empowerment and teacher reflection fitted well with the plan, act, observe and reflect of the action research cycle. The design of the professional development model was deliberately established to move through a number of cycles during Tiffany's first year of teaching, in order to meet the problems she faced at different times of the year.

With Tiffany, the cycle started at the first meeting with the identification of her first problem. In line with the notions of teacher empowerment, Tiffany nominated a concern that she wished to investigate and eventually negate.

L: Okay. Last one. If we think about doing something here, that action research type idea, what aspect of your mathematics teaching do you want to work on first?

T: I'd probably say, I would, the first thing that comes to mind is evaluating it. Evaluating maths and then probably very closely, how to make it, how to sort of make it fun maths but also get that evidence of learning out of it at the same time, like having, yeah, to be able to show that from this game, they have learnt this. So sort of that (T1).

Her concerns were, in fact, similar to those identified by Stephanie—how do I know what children can do before they start a piece of teaching and after they have finished it? The

issue was revisited at the start of the next meeting to continue the action research cycle.

L: Okay, right at the end of the last meeting, you talked about things that you wanted to work on. And there was evaluating, knowing what the kids know really, that's my interpretation of it, making maths fun and worthwhile, and using games. So you had three goes. I said one and you gave me three. Okay, we can work with that (T2).

Aspects of this idea, especially the need for games and connecting them to specific learning of mathematics and knowing what was learned, continued throughout the year and were revisited on a number of occasions.

What tended to happen in the first half of the year was that the 'act and observe' part of the cycle was rarely undertaken. This was usually due to the preoccupation of Tiffany with control. However, having an emphasis on reflecting and telling stories of classroom incidents, as part of the professional development model, allowed for this part of the cycle to occur informally and almost incidentally of the actual cycle.

As the cycle for each problem moved through, it was subjected to the reflection section, a new but related problem was often identified and a second phase of the action research cycle was started.

L: Yes, right, so what I was thinking about, if you're starting to, to start so you know what they can do, which was one of the things you were talking about. You've checked, you've talked to the teachers, you've looked at the records and—how could you do something which didn't take a long time? (T2).

It was during this, and subsequent phases, that the initial problem was refined and revisited. This happened to make the solution more applicable to the classroom constraints, such as the relative inexperience of the beginning teacher and the context of the classroom.



L: Yes I think we'd talked about that before, hadn't we? We talked about actually doing this with manipulatives or whatever you like with some kids and not the others.

T: Yes, we actually have now got help in the morning so I've got four kids outside and they're the ones which really cause these problems so the others can do more concrete things (T6).

Putting into action, a form of the action research cycle, and revisiting issues during the first year of teaching actually resulted in some changes taking place in Tiffany's classroom. The formal cycle of action research did not occur in the case of Tiffany, as the constraints of her classroom at the start of the year did not allow an easy application of the technique. This was a similar case to Stephanie. Neither beginning teacher managed to undertake the 'act' part of the cycle. The experimentation in the classroom was missing.

## Changes in the classroom

One of the aims of this study was to support beginning teachers' work in mathematics teaching in ways that complemented research findings and official document recommendations for effective practice. Where instances of 'good practice' were identified, then they would be supported by the project, with an aim to maintain them in the classroom. This section will note evidence of changes from other pedagogical practices to recommended practice as a result of the professional development input. It will identify when 'good practice' has been continued and suggest where it has not been incorporated into the teaching style of the beginning teacher, in this case, Tiffany.

From the start of the year, Tiffany tried to use materials with her children in the teaching of mathematics. She appeared to believe they were vital in effective learning and tried on many occasions to use them, often against the behaviour patterns of the children. Gradually she became more successful with their use and by the end of the first year, the use of manipulatives and concrete materials was commonplace in her practice.

T: ...with the fact that they've seemed to have gotten on to it quite well, like I thought, and they're writing fractions but they're not going to have a clue, but the way we did it, I did the concrete things with the pattern blocks and moved on ... a lot of them seem to have understood the concept of a fraction (T6).

By supporting the teacher to keep talking about her teaching and encouraging her to reflect on what had been happening, the project gradually helped Tiffany to incorporate the use of concrete materials successfully into her pedagogical practice. Without this support one might speculate that she would have concluded that the use of manipulatives as part of a teaching style was too difficult and have abandoned the idea.

The use of games and a game-playing format was another of Tiffany's strategies for teaching mathematics that was in line with recommendations. The behavioural problems of the children, and her wish for control, meant that this style of teaching was difficult to justify and apply. However, as with the use of manipulatives, the project through its principles of empowerment and options allowed Tiffany to reflect on the happenings in the classroom. It supported and devised small ways to make changes, so that eventually her wish to use games came true.

She also realised that for children to develop understanding of an idea they needed to see the same thing in different ways and in different contexts—a one-off experience was not enough. Initially, Tiffany would teach one lesson on an area and then move, in her words, 'to the next step'. In this style, some children would have an idea of what was required, but many would misunderstand, have incomplete ideas or no comprehension of the issue at all. By the end of the first year, she was working with the children more in a style that had multiple representations and multiple presentations of the same underlying concept.

T: Yeah, I will, I'm going to, I actually intend to do it again with some different material. I think they can do it, I mean I said last time, they couldn't do it, but sometimes they can. It depends who's in the group as well ... so if they're not there the whole dynamic sort of changes (T6).

Once the control factor was within manageable proportions, Tiffany could start to consider the children and their individual needs, from both learning and social points of view. Previously all children were treated in the same way, as a whole class, for reasons of ease of control and management. By reflecting on what had happened and devising ways to combat small aspects of poor behaviour, Tiffany was able to work in ways that supported individual needs.

T: Because I thought well I shouldn't give up on it, if they do it often enough and you, it's just a matter of changing the way you do it and adapting to what they can handle, and then I can sort of do it, maybe not the way I would like to, but ...(T6).

By the end of the year, Tiffany was using calculators with her children. She had decided initially that the children "couldn't handle them", and the school did not have any to use. Calculators were supplied by the 'fellow worker', which Tiffany used with a small, selected number of children and had success. The loan of resources was one way in which the project supported change in the beginning teacher's classroom.

T: Actually I'll give them back to you now ..in case I forget, because they could get mislaid. Thank you very much, they loved those calculators (T7).

The teacher reflection aspect of the professional development model proved to be useful for Tiffany, as it actually made a set time for her to think about her teaching, her context and her children. This aspect would almost certainly have been missed out among the hectic scramble and lack of time to think, which is the pattern for most beginning teachers. By reflecting on what was happening, Tiffany was able to see beyond the issue of control and begin to consider options for moving her teaching into different areas and working in different ways.

T: Well at the beginning of the year I think I said like better to sit them down there, and they do work off a sheet, or they just, that's all they were wanting to do, I think I didn't try much hands on stuff. But

the hands on I think is the most effective way because they can sit there and do the sheet but they don't really know what they're doing, whereas I think hands on first (T7).

As noted earlier and throughout this chapter, moving through the control issue was a large factor in developing Tiffany's teaching.

T: I think I stopped worrying about their behaviour as much. I think before, at the beginning of the year, I was giving them new things, well I was new ...(T7).

T: Yeah, and there are behaviour problems, but I think I learnt to deal with it much better, or differently, so that I actually get through it now and actually teach something, whereas before that was my major focus. So everything I did was sort of not letting the kids get wild. So I think I sort of relaxed that because I know I can now handle that without too much of a stress (T7).

She had moved during the year, from treating all the children as one homogeneous mass to thinking about individuals. She had moved from everyone doing the same thing at the same time, to trying to match children and task more appropriately.

T: Sitting them down by themselves, not working in groups, basically they all did the same thing, which wasn't really catering for their different abilities, but they all did the same thing, and the ones who could do it probably just finished early and I didn't really cater for extending them, pretty much just do this (T7).

## Summary

Where Tiffany tried little changes in her practice, often because of discussions during the project meetings, she saw the children succeed, which in turn encouraged her to try the same or similar things again. She was supported by the presence of the project and the 'fellow worker' to take risks with her pedagogy in mathematics. By the end of her first

year of teaching, her pedagogical practice had changed. It changed from a style of whole class teaching to one that took into account the needs of her children and used activities that engaged children in discussion and thinking. Her work now incorporated the use of materials and often a game-playing format. These were things which she wished to use earlier in the year, but abandoned due to the poor behaviour of the children. It is possible that without the reflection time and support of the 'fellow worker' she would not have returned to them for a lengthy time. The small changes made led to success which in turn led to permanent adoption of a less traditional style of teaching.

## Chapter 7

### **Case study analysis and discussion**

Case study three is Harry. As with the previous studies reported, Harry's case will set the context for the discussion and then proceed to consider evidence for each Research Question in turn. Evidence, mainly from interview transcripts, will be used to illustrate points being made.

### **Case Study - Harry**

#### **Setting and background**

The first of the male case studies was Harry. In a number of ways Harry was different from Stephanie and Tiffany—he was older, being 28, married with a family of one boy and for the early part of his first year of teaching, a pregnant wife. His route to teaching and his first classroom also contrasts to the previous case studies. Harry has a BA degree in Social Science, gained in 1994. Specialisms within this degree were History and International Politics. From 1986 to 1991, he was a full-time plumber, having gained his qualifications via an apprenticeship following a pre-apprenticeship course.

Harry's qualifications for teaching came from a one-year Graduate Diploma in Primary Education, where he achieved a final academic grade of Credit. As with Stephanie, Patrick (his case follows in the next chapter) and Tiffany, he undertook a one-day-a-week distributed school experience and three more extended periods in the classroom. He attended two Perth Metropolitan schools for his teaching practice. He worked in the first school for day visits and two complete weeks with a class of Year 3 children. In a second school, he taught a class of Year 7 children for a similar period of time. His last teaching practice was a final Assistant Teacher Placement

(ATP) with a class of Year 5 children for approximately five weeks. He finished his course with a *Highly Competent* mark for ATP in teaching.

Harry applied to and was accepted for a post at a small Christian school in the Independent sector of education. This school was situated in a semi-rural part of Perth, on the very edge of the metropolitan area. This placed it in the hills to the north east of the city, which was almost an hour's drive from the centre of Perth. The school buildings were set in bushland, a short drive from the centre of the town and were quite close to the state primary school for the area. As the school had only been in existence for a relatively short time, many of the buildings were either newly built or of a temporary nature. Harry's classroom, for example, was a de-mountable, whereas the administrative block was newly constructed from brick.

There was a full-time teaching staff consisting of a Principal, who undertook some teaching as well as administrative duties, and four class teachers. There were no specialist teachers but four part-time and support teachers added to the complement of staff. There were four classes and approximately one hundred children in the school.

As was noted earlier, the classroom Harry was assigned to, was a temporary wooden building. It was quite light and airy and had ceiling fans to help combat the summer heat. Desks and tables were quite old and were generally set out in rows. This was the pattern at the start of the year.

Children in the class were from Year 5, Year 6 and Year 7. At the start of the year, there were 25 children, six from each of Year 5 and 6 and 13 from Year 7. The range of ability, maturity and experience consequently was large. Harry described them as a diverse class coming mainly from middle income socio-economic groups. The class was diverse in ability, in age and home background, with some children coming from middle income families while others came from single parent homes. As will be discussed later three of the children suffered from ADD and were subject to medication.

Harry travelled to school each day, approximately 23 kilometres. He was contracted to teach for four out of five days in the week. He was usually relieved on a Friday by the Principal who taught all the science curriculum content. Harry's teaching load and

curriculum range were revised soon after he started at the school and he was then expected to take on more of the core curriculum areas.

## Research Question 1

*To what extent do the following factors influence the pedagogical practices of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's reactions and behaviour;
- the beginning teacher's education;
- beliefs about mathematics and mathematics teaching and learning;
- professional development;
- the researcher; and
- other sources.

For Harry, as with other beginning teachers in this study, factors, which influenced his actual day-to-day classroom practice, were not easily separated into simple categories. Some of them, namely the children, the school situation and Harry's limited pedagogical knowledge, were closely interrelated and impacted upon each other. For convenience of reporting, however, each will be discussed separately. The order of factors discussed here will loosely reflect the order of influence on Harry's teaching as identified from the analysis of the taped transcripts of meetings.

### Children's reaction and behaviour

As noted in the discussion of the context, Harry had a class that contained children from three grades, a wide range of ability within these grades and other children with psychological problems such as ADD and Dyslexia. Excerpts from field notes and interview transcripts illustrate this range of ability.



The mixed ability nature of the three grades of children ranging from 'barely achieving to Year Eight' (Field notes Feb).

Harry (H): The problem is also the ability ranges I've got. Three of my Year Fives have got learning difficulties and one of them shouldn't even be in Year Five (H4).

H: I've got four diagnosed kids with ADD, one child that's ADD and he's also got some kind of—for want of a better word—a slowness with his motor skills. Another child, that's dyslexic, that would be at the lower achieving end. At the upper end I've got children that have advanced well beyond one year higher in language and there would be one or two that would be one year higher in maths too (H3).

The combination of learning difficulties of some children and a large range of ability presented Harry with a situation with which he was unfamiliar and for which he had few answers. He used what he knew to attempt to deal with the ability range and control problems he saw—a traditional approach of teacher-directed class teaching and textbook use. By the end of Term Two, and at the time when he was feeling more confident and in charge, having survived for a semester, the issue of range of ability, ever present, became more obvious to him.

In marking the tests the results showed what I suspected for a long time, that they had a very great range of abilities. Through from children, who could only best manage 40-45%, through to children that easily reached 90% and over. And that was in each grade and it really highlights to me the range of skills and abilities I have in the class and it was useful for actually planning what I was going to do in Term Three (H. Journal 1).

Harry managed to keep a tape journal for the first two terms of his beginning year and in it he reflected on his class of children.

This is a brief round up of Weeks Three and Four. ...I'm finding the diversity in my class is again becoming a bit of a problem even in doing relatively simple maths such as number patterns and ordering large and small numbers. A number of the children in the class struggle with the concept and particularly in place value, with decimals and placing them in order from smallest to largest, even though we've done this over and over again, some children seem to take so long to get the concept. I'm finding I'm having problems now with some of my children being way ahead and some of my children still struggling with concepts. I'm finding myself looking for extra resources now, not only to extend the children that are ahead so that they don't just race ahead with our course work, but also to try and short cut perhaps, the children who are way

behind so they don't stay that far behind all the way along (H. Journal 6).

Harry was working with all the children across the age range and ability range on the same thing at the same time, much as a traditional, whole class teaching style employs with a single, year group class. He had, however, at least two age groups in his class at any one time. The diversity of the children's ability forced him to seek other material to match their needs and hence adapt his usual teaching style. He was, however, by his strategies attempting to keep children at a similar level by 'catching them up' or 'slowing them down', so they could be taught as a homogeneous mass.

The behaviour and reaction of the children to Harry's teaching and to mathematics acted as a governor or controlling factor as to how Harry could teach and how he was prepared to attempt to teach. Their reaction, particularly at the start of the year, set a pattern in Harry's mind that became difficult to change. Generally, they 'messed up' if something different from individualised textbook mathematics was attempted. The children were used to a diet of textbook examples or work from the board, and many achieved well from this approach in that they received good marks on their test papers. They did not wish to move out of their 'comfort zone' and risk failure. The Year Seven children, in particular, were also very competitive.

H: They get into competing against one another. Then I get a better response because these groups can't stand being beaten by the Sixes. But as soon as it's relaxing even the most responsible kids ...they won't think for themselves unless there's a real goal. You want to get to a point where you enjoy thinking for yourself. None of the kids are like that, even Jody and she is, well I think, Year Nine [in ability] ...right up there 99.9% maths test, that sort of thing. But even she won't do it, she is by far the most able but she won't do it. It must be a maturity thing more than an ability thing (H4).

Some children had enough self-control and generally did not misbehave. Others, however, were not able to control themselves in a way wanted by Harry. His experience of working in non-textbook ways was so negative, it overshadowed the positive aspects which were there. The negative experiences led him to decide that

these children could not work in any way other than with a traditional pedagogical approach.

H: But my Year Sixes, the other day were doing volume and measuring the capacity of six containers. Water and kids, you can just imagine, can't you? I left them unsupervised, just checked now and then, out there in the courtyard, they were quiet, did the job, did the graphs and were good. These guys [Year Seven] couldn't even do it supervised. I'm not going to do volume and capacity with them. It's not worth even thinking about. I'll bet you any money you like, no matter what I do it's going to happen (H4).

H: The one before that was shapes and they had to do symmetry. I said five minutes play. Wonderful big mosaics, patterns you know, little towers and things but they couldn't control themselves. I'm still finding shapes (H4).

Not all experiences were negative as was mentioned above. Harry noted some very positive responses usually with the Year Six children. He was more inclined to repeat these with the Year Six children who could 'handle it', as shown below, but often the need to work at the same time with the Year Seven children made him usually reject this as a course of action.

H: We did researching favourite foods in the school using the categories of fast food, dessert and home cooking and soft drinks and they loved it. Interviewing each other, tallying, getting all the tallies right, putting it in table form and then putting it in graph form then coming out the front and doing reports and showing the graphs. Jeez it worked well (H4).

This style of teaching was in the first semester of his first year. Even in the second part of the year when the Year Sevens were taken out by the Principal, Harry was still reluctant to work in 'more relaxed' and less teacher-centred ways. This was due, in the main, to his experience of the earlier reaction and behaviour of the children.

The number of children in the class also increased during the year, adding to the management issues faced by Harry. In most cases, it was not just a relatively simple problem of an extra body or two affecting his ability to manage more children. It was often more a case of expanding the range of abilities exhibited in the class, as the entrants were of special cases or had special needs.

H: Plus my class has grown. I've got 27 now and another two coming soon, 29 (H4).

And another thing ...my class grew by three children, two Year Fives and one Year Seven, and of the two Year Fives that were added to my class, one has a diagnosed learning disorder and the other one simply has been a difficult child and, just no one has bothered with him, and they've both come into my class at what I would estimate to be around the Year Three level. That would be across the board, in fact one of them has difficulty even writing his own address. Mathematically neither of them has much confidence and they struggle to gain concepts. One of them, the one with the learning disorder, just needs more time and individual tuition in order to get through things, the other one is simply a lack of confidence (H. Journal 1).

Harry was being forced into or at best restricted to a teaching style that would keep poor behaviour in check. He chose this style of teaching as it would allow him to manage a larger class and afford him some way to cope with the growing range of ability and special needs of the children. A traditional textbook approach would enable him to set everyone to work and give him some time to work in more depth with the less able children.

Open-ended tasks, as one way to cope with the range of ages and abilities, were not considered by Harry. He had a negative point of view, and a limited experience of them, which made him reluctant to attempt to use this style of teaching task. His experience with the Year Seven children, who, in his view, just wanted the answer and did not wish to think, not only encouraged him into rejecting open-ended tasks as a way of working but also confirmed his view that they were of little use as a vehicle for teaching mathematics.

H: ...Cause all the kids, especially the Year Sevens, they just like to get an answer. They don't like setting out, they don't like telling how they got an answer, all they know is that this is the answer ...(H6).

H: ...They don't seem to like thinking.

L: Is that because they are not good at it?

H: Possibly. I don't think they've done much. I certainly haven't done much. I really get the impression that this school focuses on number crunchings and they're really good at it (H6).

As the year progressed and the Year Seven group was removed from the mathematics class to work with the Principal, Harry became more aware of the children's actual abilities. A small number of the children reacted well to more open work or work that demanded more thinking and understanding rather than remembering and repeating methods. Harry's thoughts about them were based on one experience of these children working in this way. They had used water, something that meant that Harry had to let them work outside away from his direct control and input. Much of his thinking and opinion in this area was based on this experience and his projection of this into hypothetical situations as children rarely worked in these ways.

H: I could do it with my small group. They are well behaved. I mean some of them are so immature in terms of their behaviour and in their thinking that they would just not cope with it, and they've never had it before, but the older ones, the more mature ones would love it. They'd love the opportunity to think, "Oh you know we could do this or this and this", and they'd enjoy the fact that there's a range of answers (H6).

The behaviour of the children in the class generally directed Harry into a particular teaching style. Certainly, however, and especially in the first part of the year, Harry did not take a lot of forcing as he believed that this was the correct way to teach mathematics. With the removal of the Year Seven children, and a growing awareness of the rest of the children Harry was able to redress the balance in favour of those children. He considered that they had missed areas of their mathematical teaching because of the demands of the Year Sevens. There were also fewer children to manage and organise, a factor that also made Harry's pedagogical selection more open. However, while this style of teaching became an option, Harry rarely worked in such a way, preferring a teacher-centred, textbook, traditional pedagogical style.

## The present school context

The main part of the school context which impacted upon and influenced Harry's teaching style and effectiveness was, as already discussed, the imposition of a multi-grade class, with not just a two year but a three year gap. Apart from this factor, the school context had other more subtle influences on his pedagogical practice and on his mathematics teaching.

Harry was contracted, initially, to teach for only four out of the five days in the teaching week. The Principal taught the other day, Friday. Later in the year, the Principal began to teach the Year Seven children for mathematics. While Harry did not mention it specifically during the interview, there was always a feeling that the Principal was aware of what was happening in Harry's classroom and from this awareness making judgements. The taking over of the Year Seven mathematics was interpreted as a supportive gesture. It could also have been seen in a more negative way, however, as an overt comment was made that the Principal thought he ought to work with this important group, rather than the inexperienced and, struggling for survival, Harry.

The problem I found with both of them though is that, in having a three-way split, it was difficult enough organising all the mathematics and organising children without having children who are either very, very far behind or with learning difficulties of that nature and they actually threw my programme into some sort of disarray and I hit the panic button for a week or two there as there was no way of incorporating these two [new children with learning problems] into the system as I was running it. I ended up having to go back and sit down with my Principal and really look at what expectations I should have of these kids, of all the children, not just these two, and specifically for these two. What sort of goals we should be looking at for improving them and for building up their confidence and self-esteem generally, but their confidence in mathematics particularly. As a result of these two coming into the class and the increasing numbers of Year Sevens (I actually picked up another Year Seven towards the end of term as well, bringing my class to thirty), what the Principal and I decided to do was to split the maths up now where I'll be taking the Years Five and Six and he'll be taking the Year Sevens for maths every morning. This has helped me greatly, obviously in my planning, but it also gives me a chance to focus more on the Year Fives and Sixes. I tended last term because the Year Sevens were the more demanding children in the class, demanding of attention, and demanding of stimulus I guess for work, because they are a bright bunch, that I spent most of my time with the Year Sevens and a minimum time with the Year Sixes and Fives. That was reflected, I think, in the results of their maths tests. So in the coming term, Term Three, I'm looking forward to spending a lot more time with the Year Fives and Sixes, particularly with the children who are struggling, I'll only have sixteen then for maths, and I'll be able to give them more personalised attention that I think they need to get ahead. ...I always had

a problem last term in being able to spend time improving their mental maths capabilities, while at the same time trying to teach the Year Sevens other maths concepts. This coming term I should be able to do that far more effectively (H. Journal 1).

Harry often spoke of his wish to be seen by the other teachers as very competent and professional; being able to do more than merely cope; to be judged as an excellent teacher.

Support from the school for Harry and his development in the first year, in any explicit form, was limited. There was not a plan or policy in place in the school to support the beginning teacher. Support was in the form of a member of staff who might 'pop their head into the classroom to see if everything was going okay'. Usually, however, Harry was completely alone. As with the other beginning teachers in this study, Harry did not seek help very often, the action noted earlier was one of the rare occasions on which this happened. Like Stephanie and Tiffany, he did not wish to establish a perception of weakness in the eyes of his colleagues.

Expectations from the school were not explicitly voiced. Harry was left to set his own standards, as well as try to guess what was expected of him about mathematics teaching and outcomes from the children. Harry felt that he must use the *West Australian Mathematics* series of textbooks because everyone else used them. Thus, part of his teaching style was governed, not by any conscious decision by Harry as to the worth or otherwise of adopting this approach, but by an unvoiced feeling of what should happen. Harry noted in an early meeting that the Principal had wished to 'hit number hard, especially place value' and this Harry put into action. Other comments of a similar nature occurred from time to time throughout the year. Later in the year he was 'instructed from up high to do it [speed and recall with instant mental answers]'.

Generally, however, Harry was left to work out the expectations of the school.

H: ...I didn't get the general thrust of where the school was going, get an idea of what the standards really were in the school as well as in my class, what they had been taught. Small things like teaching measuring angles, which isn't in the syllabus until Year Eight, and I'm not sure but there's not many in the WA maths books, they're not in MTS, it's not in any text, and I'm taking the assumption that it's not in the [primary] syllabus but they would teach it here in Year Five, and not knowing that. It wasn't till the end of the year that I realised that I had to teach it. ... Little things like that would have been handy to know, but I've only found out as I've worked through the year (H8).

Harry was always aware of the Principal and his promotion of mathematics being of a traditional style.

H: The Principal's a bit of a maths and science person, so he's big on problem solving [word problems]. What he wants us to do is to go through all the basics first and then some problem solving. I've done that, I've done quite a lot of problem solving and I like it because it's more closer to real maths again than anything else (H6).

H: ...my feeling is, maybe my perception is wrong, my perception of the school is that they have a really old fashioned approach to maths and that new ideas like working mathematically or things slightly not clear in their objectives or not specific would be "Oh that's a nice maths game, now let's get on with the real maths." That's the focus in this school. That's my perception (H6).

Harry's perception of the school and its expectations of traditional mathematics teaching and content, combined with his own belief and children's reactions to a teaching style that was slightly away from the norm, meant that a traditional pedagogy was maintained and reinforced. Making change was even more difficult to achieve in this beginning teacher's classroom.



Support from the school, in the form of materials to use, was also limited. The school was new, and had limited funds. The budget for the purchase of support materials and resources was small. Accumulation of materials had not occurred due to the age of the school. Possibly, the reliance on the textbook as the teaching focus made the use of materials obsolete. There was no evidence that Harry had asked for materials or had tried to order any from the Principal. It appeared that he had not brought materials and aids from home. Harry mentioned that the school was to take delivery of some computers early in the year. There was no evidence from interviews or from observations that they formed part of his general teaching or specifically his mathematics teaching.

There were also more subtle pressures from the school to adopt a specific teaching approach. Towards the end of second term, the Principal announced that he had entered some of the older children into national mathematics competitions. Harry felt that this put him under extra pressure to ensure that his children performed well in the competitions. As a result, he undertook a further round of teaching which emphasised speed, recall and performance of traditional algorithms.

The Principal offered specific advice on how to bring the writing of a mathematics programme into line with the realities of time and energy. He also, at the end of Term Two, at Harry's request, discussed the setting of appropriate standards for individual children. The idea that Harry came to put into practice after the talk was not to try to make all children the same, to bring them to the same level of competence in mathematics, but to try to improve each child. In this way Harry attempted to use the Principal's advice to solve his problem.

H: ...So now I've tried to make it more individual and I'm keeping a lot more notes on where each child is at. They've all got to improve, that's my standard now ...I will feel that I've succeeded if I've got them to improve, rather than say, you know, I've got them to Year Five standard when they've come to me as Year Three standard (H6).

The fact that the Principal took the Year Sevens for mathematics after Term Two meant that Harry could start to think about how he was teaching mathematics. The

complexity of the teaching task had been reduced and Harry had moved out of 'survival mode'. He had moved into a more 'thoughtful mode'. He did not seem to want to adopt a pedagogical style that was far from that of a traditional approach of teaching to the whole class the same undifferentiated content. He started, however, to look to the needs of individual children. Before this time, all he could do was to say, "I know this is wrong, but I can't do anything about it" (H3).

## Pedagogical knowledge

Discussion in this section will revolve around the issue of Harry's pedagogical knowledge. Harry knew about other teaching techniques and teaching strategies, as they had been part of his teacher education course. What was less clear from the data available was the amount of experience Harry had with implementing these strategies or seeing them used on his teaching practices. It appeared that Harry had rejected other ways of teaching apart from a traditional, teacher-directed style. Harry believed that a traditional teaching style was the way to teach and that group work and child-centred approaches would not work. He had had no experience of implementing non teacher-directed strategies and possibly did not have the management and organisational skills to undertake them.

From his first day with the class, Harry was faced with the problem of organising, managing and teaching children from three year levels. He had to deal with a range of ability not only in mathematics but also in other curriculum areas such as Language. He had limited pedagogical knowledge, as is the case with most beginning teachers, and only a short experience of actual classroom teaching. Experience from his visits to school, as part of his teacher education course, had shown him class teaching 'to the middle'. In this style, every child did the same work at the same time. Those who grasped the idea of the task finished early while those children who struggled with the activity or learning were helped by the teacher or did not complete the content of the lesson. Harry, with his limited pedagogical knowledge and experience, was not able to solve the very complex pedagogical problems at the same time as he was attempting to manage and control the children. Throughout the first semester, and to a certain extent throughout his beginning year, he was faced with decisions to be made, dilemmas to be managed and conflicts to be resolved. Decisions had to be made between what he felt he should be doing and what he was physically and

intellectually able to do. Most of his pedagogical practice was of a traditional nature, because that was what he not only knew about and had experienced as a teacher and as a pupil, but also fitted his beliefs about mathematics teaching.

Later in the year, he was freed from some of the control and management problems but his limited pedagogical knowledge restricted what he was able to consider in terms of development in teaching style. In Term Four, he began to think beyond 'teaching to the middle' and to take into account the needs of the different year groups. He was still focussed on year groups rather than actual ability levels.

H: ...When I think of introducing new topics I still like to teach the whole class at once. When I introduce a new topic I try to think how I can introduce it so the Year Fives will understand it and then move on from there, get them working and then move onto the next step with the Year Sixes (H7).

Even with the smaller class size, while Harry spoke of more individual work, what he meant was a teaching style that relied on children working from textbooks, as the main way of working individually.

H: I'm teaching them more individually because I've only got fourteen kids. I find I have a lot more time to get round and individually deal with each child. ...Most of the teaching is around the board and we'll do it together and I've programmed so that I'm doing the same subject or the same themes if you like cross grades Five and Six say fractions which we're doing at the moment. I look at the joint concept of mixed number stuff on the board and equality and then the Year Sixes go off and do their level of work and the Year Fives do their level of work from there (H6).

The pedagogical style was one of children working in the same content area of mathematics, for example, fractions, but each child was working from an individual book or worksheet. There was no interaction between children, no group work and no discussion. The children worked through the content pages of the mathematics textbook. Later in the year Harry allowed children to sit together and moved the desks

and tables to allow children to help each other if they were unable to complete the work.

H: I focussed on getting the group work idea going all the way through the year. See even when they were sitting the way they were I encouraged them to help each other out and I've always used the more able kids to help the less able kids. ...to be perfectly honest my focus is on classroom management not on the mathematics (H8).

The style of teaching, although the children are loosely in groups, was not a group learning style. No interaction took place about the mathematics, apart from the children who understood what to do, telling those who did not. This was a peer mentoring interpretation of group work. It was a way for Harry to manage the need for attention and clarification of a large group of children. At the end of Term Four, Harry was preparing to try group work ideas in Social Studies, his specialist area, but there were no plans to attempt it as a pedagogical style in mathematics. The main reason for this reluctance was, as Harry said, "well I guess it's the same as with language isn't it, grouping in maths, I mean it could work in the same way, but I wouldn't know because I've never tried it" (H5). A combination of lack of confidence and lack of pedagogical knowledge had restricted Harry's choice of pedagogical practice in mathematics. Harry knew that group work was another way of organising a class but it appeared that his knowledge was superficial. He seemed not to understand the reasons why such a teaching style was useful and appropriate in mathematics teaching.

Harry's knowledge of planning and programming was limited and this in turn restricted what he was able to do. It also pushed him towards the use of a textbook for his teaching, because by using the textbook he thought he would be able to cover the syllabus content. From his experience of teaching practice, the only planning style he had seen used by his supervising teachers was the adoption of a textbook format. Further knowledge of the planning process and how programming could account for different ages, different abilities and different styles of teaching might have helped Harry adopt different pedagogical practices. Issues such as these had been part of his

teacher education course but had little impact on his planning in his first year of teaching.

Harry was also limited in his pedagogical knowledge of how to analyse mathematics contained within an activity. For example, he dismissed puzzles and games as a waste of time, because he could not see how they might help his class learn mathematics. For Harry they were recreational or pastime activities and could be omitted, even when they were in the textbook, in his drive to cover the syllabus. Tessellation was seen as “a real waste of time. Nice to know but not necessary” (H3). Harry talked about mathematics being only of use when it could be used in real situations. If he could not make these connections between mathematics and reality, he did not teach the content area or page in the mathematics textbook. A consequence of not being able to analyse the activities was that he taught only the content he recognised as mathematics, and that was number and algorithmic procedures. That was what he did, especially in the first part of the year. Harry's understanding of what actually constituted mathematics was different from the conventional definition used on his teacher education course. As noted above it dictated what he selected to teach and the sort of activities children should undertake.

Another consequence of Harry's limited pedagogical knowledge was that he rarely organised the class to use materials to support or develop learning. He appeared to be unsure but not unaware of the critical role of first hand experience that concrete materials play in the development of children's understanding of mathematics. Their use did not have a high priority in his planning and organisation. He was also reluctant to use materials, as noted earlier, due to the children's reaction and poor behaviour when he introduced manipulatives. Often activities requiring materials were omitted due to Harry's poor forward planning skills.

H: ...for example you are doing measuring of time in seconds and what have you. In three pages that deals with it, one page will be a nonsense page and I can't deal with it so I'm down to two pages. One of them involves kids timing how long it takes them to get home. How long it takes them to eat breakfast or something. I mean, I just can't do it in a lesson. ... And so every week when I come I'm not organised enough to plan a week ahead, I do it

either at the weekend or the night before and usually I end up not doing it [work involving materials or children researching data] (H4).

The resources were available in the school for most of the activities, but Harry was unable to anticipate their need and therefore organise them appropriately. A consequence of working as a whole class was that if Harry managed to note a need for resources in an activity, he might find that there were not sufficient pieces of apparatus for each of the children. If on the other hand, he had used a group work pedagogical practice, he could have overcome this deficiency and used materials to support the children's learning, rather than abandoning their use. This indicated also a further example of limited pedagogical knowledge.

H: ...Another one says use stopwatches. Can you imagine ordering 25 stopwatches just so you could be accurate and measure time?  
No school's going to buy 25 stopwatches (H4).

Harry's pedagogical knowledge was also limited, when it came to developing tasks to match the needs of his class. Children who were experiencing difficulties were helped either by Harry or one of the brighter children in the class. Further questions or requirements did not extend those children who completed the task. They just finished quicker and proceeded to do something else. Harry was not able to or did not want to delve deeper into the learning in an effort to develop understanding. When one task was completed, Harry moved onto the next step in a very shallow, linear development of the content. His understanding of the learning process was superficial as well as his ability to organise the class in different ways. There appeared to be a question about his ability to analyse the mathematics contained within activities and a content area. The complexity of learning was not appreciated. He seemed to have an 'empty vessel', transmission approach to complex learning situations. This translated into a teaching style that used a linear development of small steps of knowledge. He did not have a constructivist outlook, which was reflected in his teaching and planning approaches to mathematics.

Assessment was another area that by Harry's inexperience was restricted to a traditional style. Assessment was by pencil and paper testing at the end of the teaching sequence.

H: ...the end of term tests that I ran with the children, and I experienced a few problems with it. Firstly with the Year Sevens I think I planned too much. The tests virtually covered the whole syllabus, because we've covered the whole syllabus in Year Seven, and many of them had a hard time finishing on time (i.e. within the hour and a half I gave them). I ended up having to give a number of students two days to finish the maths test in and I'm not sure how effective that will be in planning in the future (H.5).

Apart from the mismatch between the test and some of the children, the impression given was one of a secondary school style test. Harry appeared unaware of the value of other styles of assessment such as portfolios or observation, and hence his pedagogical style concerning assessment was limited and traditional. It was not a fact that he did not know of these other styles of assessment, as this had been a focus in his teacher education. He had chosen not to use them, possibly because he did not believe in them and could see no worth or could not manage and organise them in his classroom. This fitted into a practice of teaching content in a procedural way, followed by a test to assess if the children had remembered the correct procedure. Repetition was used to practice the method, until it was completed correctly. Harry also used the word 'concept' to mean a mathematics fact or a method, rather than the development of a 'big idea'. For example, being able to complete the addition algorithm using the standard method was used to suggest that the child had grasped the concept of addition.

The impression gained from data related to Harry's pedagogical knowledge was that it was limited. Limited, maybe because of inexperience but also limited by his traditional belief. An example drawn from the data showed his knowledge of mental mathematics to be restricted to recall of facts and the use of simple contexts for setting calculations. This is a traditional pedagogical view. There was no mention of the development of strategies for calculating mentally, a more contemporary view of mental calculation. The development of mental strategies had been a focus in his

teacher education course. As with many issues related to teaching mathematics, Harry had developed only a superficial grasp of the idea. He had filtered out the parts of the course he did not believe in.

## Professional development

Harry did not engage in any professional development, other than as a member of this project, during his beginning teaching year. The influence of this project will be discussed as a part of Research Question Three, later in this chapter. Harry's school was part of the Independent School Sector. There is no data to suggest that Harry received any contact, professional development or support from the organisation during his beginning year.

## Teacher education course and school experience

An impression was gained that much of what was encountered during Harry's teacher education course was different, and possibly in conflict with Harry's views. It might be suggested that his teacher education course had no influence on Harry's actual classroom practice or his underlying belief system related to mathematics teaching. Harry was aware of the messages of the teacher education course. Very early in the year he commented, "...you wouldn't like my mental" (H2). By this comment he meant that he was doing purely speed and recall testing of tables and number bonds rather than using discussion of children's mental strategies, as had been the emphasis on his teacher education course. His way of working, early in his beginning teaching year, was very different from the illustration and examples provided by his teacher education course. It appeared that the messages from his course regarding pedagogical practice and the teaching of mathematics had been 'filtered out' or were beyond his capabilities at that time.

The school experience situations undertaken by Harry, as part of his teacher education course, appeared to offer little in the way of positive influence on his classroom practice. Opportunities for Harry to learn in these situations were limited. He had seen little mathematics taught and had taught very little mathematics himself. The range of teaching strategies observed in his school experience was narrow, being mainly whole class teaching from textbooks or worksheets.



H: ...I didn't have any experience of teaching maths to be honest with you. The maths I got on my ATP was all the stuff, the dregs the teacher didn't want to teach (H4).

He did not experience any teaching of space and measurement or see children working mathematically or in a problem solving way. Thus, his ideas about teaching mathematics, gained from his time as a pupil, were not exposed to conflict and scrutiny. He also saw no examples of mathematics taught in ways other than by a traditional textbook and teacher dominated method.

H: When I first started I wasn't all that confident at teaching mathematics. I didn't do it on my ATP. I didn't program for it, so I didn't have any idea where to start ... (H7).

His lack of programming experience, as noted earlier, meant that he was restricted to adopting a traditional approach to teaching mathematics. There was, however, some positive influence on Harry's practice, in particular his classroom management, from his teacher education school experience. The ones that were adopted appeared to be the ones that were complementary to his beliefs about mathematics teaching. The system was copied without any questioning or understanding of the rationale of the particular method as illustrated by his journal entry below.

What I've designed is a system, or the system I'm using is the one that I learned from the Year Six/Seven teacher on one of my pracs when I was at Uni. It's one where there are only two or three copies, or actually three copies each of the marking sheets so that only a small number of children at any one time can be marking, and we're just sort of rotating this around... (H. Journal 4).

Some of the aspects of the school experience had a negative effect on Harry and provided influence on his classroom practice from the point of view of what he would not do.

H: One of my teachers last year on prac couldn't even understand the WA Maths. What was even worse he was teaching Year Sevens WA Maths, the WA Maths book, he wouldn't even plan the night before what he was going to do, so he'd get in front of the class and say open your books to such and such a page and not

be able to do it. And that's an enduring memory, I thought, 'You've gotta be joking' (H6).

Harry was aware of poor practice and strove to avoid that trap. He was quite confident in his own mathematical ability with traditional methods for number. He was less confident with open-ended tasks, investigations, problem solving and work in shape and space—they were not part of his own education and often he avoided doing similar work with the children. This insecurity was often used as an excuse not to adopt a non-traditional style of teaching and the associated open activities. They were often dismissed as not worthwhile or irrelevant to the real world.

Harry noted some influence from his teacher education course in that he tried to make mathematics practical and related.

H: Through going to Uni I try to make mathematics as practical as possible as related to everything else as possible, as meaningful as possible. And I try and sort of tie that in as much as I can to real life and give the kids problems that are based on real life situations. I try at all costs to not make mathematics this subject that's just right out there, not related to anything else, not related to life, like as much as possible integrate it and make it meaningful. That's the bottom line to try to make it meaningful (H7).

Throughout the year, he talked about using real life situations for mathematics. Possibly, his background in plumbing afforded him this bias to the need for practical application of mathematics. This was usually what he meant by 'practical'.

H: ...We can work out how much carpet you need to cover the classroom floor, or they can bring plans from home, house plans we can sort out if tiles cost \$25 a square metre, how much would it cost to tile the lounge room or part of the lounge room and so on (H7).

The real life situations generally consisted, in a simple form, of the traditional word problem – e.g., Mary had five apples and bought six more, or traditional application

contexts, for example, buying carpet for floor areas. He did not move into actual problems, or use real data or use situations that were real and present for the children. He did not incorporate problems that involved a more open and possibly ill structured format, such as children investigating a situation and offering their thoughts and advice based on the mathematics undertaken.

Harry felt he did not learn much from his University course that he wanted to know. He appeared to want a straightforward formula for how to teach mathematics and to have a revision course for the correct method to calculate using long division. He could then repeat the correct method for the children to learn. A simple transmission of knowledge approach to teaching mathematics.

H: ...I didn't learn a lot about how to do it at Uni. I mean I learnt a lot about the classroom environment, how to set up a classroom environment that's interesting, and I think that's interesting, it's relevant and all that, but the actual, the nuts and bolts of how you do long division, how do you know, the formal multiplication, how do you do addition, subtraction and fractions, what's the relationship between the percentages, decimals, fractions? Those things we didn't touch and I hadn't thought of those for nearly ten years really (H7).

At least six weeks were spent, over quarter of the allocated time for his teacher education course in mathematics, on very things he said he did not receive—the 'nuts and bolts' of how you do and teach multiplication, addition etc. With hindsight, it would have been interesting to see what Harry thought had happened in those university sessions. What he also seemed to be asking for was a reminder of the mathematics content, that is, the correct method for setting out long multiplication. This had not formed an explicit part of his course.

Ideas for assessment, for example portfolios, were discussed during the course though Harry appeared to have no memory of the dialogue or activities. Possibly, Harry's strong belief about mathematics teaching was an overriding influence here. He appeared to have filtered out alternative views of assessment. He expressed non-traditional views as part of the course. One of the activities that Harry undertook

asked him to make a presentation on alternatives to testing, as part of a section on assessment strategies in mathematics teaching. Harry gave a presentation that outlined a range of alternatives to the test. These views were filtered when he reached the classroom. In the classroom, Harry's traditional belief orientation led him to think that you assessed children via a test.

H: That's a good idea. Is that what it was about, the journal. I wondered what it was. I never understood it at the time and thought, 'Oh well, I've got all these other things to think about'. I mean I knew about language journals, but not the same, not the idea with maths. I never thought of it (H7).

This was another example of the belief system filtering out information and ideas, which were in conflict with ones held already. Possibly, also the concentrated and intense nature of his course meant that he had to adopt limited procedures in order to survive the teacher education year.

By the end of his first year of teaching, Harry was able, with prompts, to reflect on experiences from the teacher education course. He was aware there had been an emphasis on learning and acknowledging children's individuality. He knew about it, but generally did not or could not do anything about it in the classroom. There appeared to be only limited influence of the teacher education course on his pedagogical practice in his first year of teaching.

### The beginning teacher's education

Harry's own education could be seen as a minor and not fully explicit influence on his pedagogical practice. His memories of his mathematics teachers were good. These were mainly High School teachers with a traditional teaching style, which could possibly account for his traditional beliefs and approach to teaching as he had been taught in a textbook and teacher-centred way.

L: What sort of things do you think have a big influence on what you do here in mathematics teaching?

H: What I was taught and how I was taught as a child actually.

H: I'm not sure. The way I run my classroom isn't based on that, the way I run my teaching, but how I teach long division, long multiplication, any of the formal mathematics, I actually rely on the same ways that I was taught when I was a student myself. Unless I've learnt a better way since, but I think I rely more on my knowledge in those areas than I do on anything new at the moment. So that's a big influence on how I teach (H7).

Harry had followed the cycle of 'teach how you were taught', but Harry had an interesting version of that influence. He worked with children in the same way as he was taught. He taught them the same procedures he learned for completing calculations. Although he said he did not teach mathematics in the same way as he was taught, and no evidence was offered for how that was. However, by the fact that he relayed traditional algorithmic procedures to his class would suggest that he also was taught in a similar way.

## The researcher

This aspect will be considered further in the later section, which discusses Research Question Three, thus only a brief comment will be made here. As with the other members of the project group, we talked and discussed aspects of Harry's classroom practice. Options for action were highlighted and actions agreed. The materials and ideas that were offered were usually put to one side to be used later. There was little obvious influence by the researcher on Harry's classroom practice. Possibly the suggestions were too hard to understand, beyond his pedagogical experience or ability, conflicted with his beliefs or more likely would have interfered with his speedy push to cover the syllabus and the necessary procedures for calculating.

## Time constraints

For many beginning teachers, lack of time to do everything they feel they need to do, was a large factor. Often inexperience meant that everyday tasks took much longer for the beginning teacher to complete. In the case of Harry, he was balancing a home, a family, a pregnant wife and hospital trips, as well as acclimatising to a new position and a new classroom. Early in the year, he noted the 'getting-on-top-of-you beast' as

he began to survive as a teacher. The combination of longer time to complete tasks and the sheer volume of tasks presented a huge problem of organising personal time.

Not only was he attempting to organise himself but he was also trying to make sure that everything was ready and available. This was a difficulty. Resources, in the form of hands-on materials, were very hard to find. For example, there was one set of MAB for the whole school. He had to 'beg, borrow and steal' bits and pieces to make his mathematics teaching broader. For Harry, it was easier not to do the task if it required the use of materials. Thus, he moved towards using textbook pages, which required no materials or pre-lesson preparation. Issues regarding the use of materials were discussed earlier as part of the section on Harry's limited pedagogical knowledge.

Preparation time was a problem for Harry. Whenever he used the textbook, he generally missed out those activities that required materials, surveys, or lengthy data collection. He deleted them from his pedagogical practice because he did not have enough time to prepare adequately for them. Often, also, these types of activities took more time than one lesson and the length of time needed was a factor in Harry avoiding them. He appeared to have a mindset and a desire to cover aspects of learning quickly, which required one lesson for learning an idea and then moving on to the next piece. For him, activities that took more than one lesson were an extravagance.

By the end of Term Two, Harry's class had finished the textbook designed to take a year and had completed the syllabus entries in number for the year.

Last term [Two] we finished with WA Maths, we've actually been through the whole book and a good deal of extra material as well, and I'm basing my programs on the MTS series in mathematics this term (H. Journal 2).

Harry's concern to cover the material and his simplistic notion about learning were well illustrated in this extract from his journal.

This is a round up of the first week of Term Three, and it's been an interesting week. I've had difficulty actually fitting into my new maths programme and actually having four days where I'm teaching half an hour of maths a day as adverse to three days where I was doing forty-five minutes. I found it a little bit more difficult to fit everything in and especially finding time to mark (H. Journal 4).

Harry's concern to 'fit everything in' started to impinge on other aspects of his classroom practice. Finding time for marking became an issue. The dilemma of having time to work with individual children but also finding time to mark their work had to be acknowledged by Harry.

By Term Three, Harry has softened his approach to syllabus coverage. Having already taught the complete syllabus for the year, he was now beginning to consider the children and their needs.

H: So that was a sort of the program driving me in that sense. I'd think 'I've got to get through this', now I'm thinking, 'What can I get through? What's most valuable for the kids to get through? And that's the other thing with the kids that are struggling. There are some kids in my class that will not cover the whole syllabus. They won't do it (H6).

He did not, however, teach mathematics like he taught language because he did not have the time or resources.

H: ...Like I don't see maths as being drastically different to language teaching. I can do with maths what I do with language if I had the time, the support and the resources to do that (H8).

He said he could teach maths like language but he only had half the time for maths and so adopted a more teacher-directed, traditional approach.

Harry had to balance the time given to school and his class with that needed by his family. The immediacy of family matters, like the arrival of a new baby and caring for a young son, impacted on the amount of time Harry had for planning and preparation of mathematics.

## Other sources

There were a few other issues that acted as an influence on Harry's classroom practice; the Western Australian Mathematics Syllabus was one of them.

Harry was quite dismissive of it, in that he found it “too difficult to work with” (H3). He did, however, use the textbook titled *Western Australian Mathematics* (WAM) which was ostensibly aligned to the Western Australian Mathematics Syllabus content. He found it easier to work from this source rather than use the syllabus document for planning. The whole area of planning and programming was an area of concern for Harry, as noted earlier.

Using the WAM series forced Harry to confront his beliefs about mathematics. The textbook contained puzzle type and recreational tasks, such as moving matchstick patterns to realign them. This type of activity, Harry considered a waste of time, as it did not fit his view of mathematics. It was, however, in the mathematics book so he felt he had to do it with his class. Often, however, he would miss out these pages and move into the ‘proper maths’.

I’m also finding the MTS maths program a lot more logical and sensible I think than the WA Maths program was. It just seems to be a lot clearer in the objectives it wants the children to meet in each of the exercises they do. WA Maths often became a little bit obscure and quite frankly it seems as though it was designed by maths specialists, not with communication at the forefront of their mind. I often used to spend an awful lot of time just trying to understand exactly what the WA Maths exercises wanted the kids to do rather than actually reaching the objective of what the exercise intended for the children to learn. I’m finding the MTS a lot clearer and a lot more easily managed in that way. The children seem to prefer it as well (H. Journal 4).

Finding the right textbook was an issue for Harry. A combination of the WA Maths textbook and his early concern to cover the syllabus, brought about a pedagogical style of speed and shallowness, which took little or no account of the needs of the children. *The Mathematics Today Series* (MTS) and a realisation that slower might be more effective allowed Harry to concentrate more on the learning actually experienced by his class.

Commercial material in the school, for example the mental maths books, also influenced what he taught and how he taught it. Mental mathematics became a lesson of going through the ‘sets’ as dictated by the textbook. Harry was aware that in many cases, it was not relevant or appropriate and, for many children, it was meaningless. He was aware of these limitations and wanted to work more ‘in reality’ but he had not found a suitable textbook. He had not incorporated this pedagogical style into his



teaching. Thus, the textbook available was a strong influence in the pedagogical practice in Harry's classroom.

The issue of programming was continually discussed, as has been noted earlier. As he was unfamiliar with how to programme in mathematics, he was forced to rely on a textbook system and his knowledge and belief about mathematics to form his plans for teaching. He emerged from his teacher education programme and his school experience without a confident knowledge of how to plan for mathematics teaching. He resorted to the 'Chalk Busters' approach in desperation for something to do. The commercial '*Chalk Busters*' book has a linear, cut and dried, procedural approach to teaching maths. Each week and then day of the year have a designated lesson to be taught, so that the syllabus content was covered.

The use of a mathematics textbook in Harry's class meant that generally, children were interacting with a page of mathematics. Usually this happened individually, but was subject to Harry checking how they were doing, and offering help as necessary. Any interaction with other children was at the level of helping to overcome difficulties—another teacher rather than as a fellow learner.

A major factor in Harry's pedagogical practice was the textbook available for him to use. In the case of WAM and MTS they confirmed, more or less, his beliefs about mathematics and mathematics teaching. Where they diverged from his belief he generally left that part of the book out of his planning.

## Summary

Harry's pedagogical practice was mainly influenced by two things—his belief that mathematics was about the transfer of calculating procedures, and the negative reaction of the children to a teaching style that was not of a traditional form. Harry's lack of a depth of pedagogical knowledge may also have contributed to the narrowness of his practice. Any different methods for teaching of which he was aware had then to pass the test of scrutiny of his and his children's beliefs, before they were to become classroom practice. Generally, they did not pass, and Harry maintained a traditional, teacher-centred approach to teaching, which relied on the quick transfer of knowledge about number calculating procedures and facts. The textbook which

allowed him to work quickly through the material of the syllabus without having to translate it into lessons, was an influence on his teaching style. The textbook was explicitly connected to the syllabus, approved by the school and parents, and reflected a philosophy akin to Harry's beliefs about mathematics teaching. By using the textbook his lack of knowledge of how to plan for mathematics was overcome as he could now plan to cover a number of pages. This would constitute his mathematics program. The approach was complemented by the generally implicit philosophy of the school context.

## Research Question 2

*To what extent do the following factors influence the pedagogical beliefs of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's reaction and behaviour;
- the beginning teacher's education;
- professional development;
- the researcher; and
- other sources.

Teacher beliefs about mathematics teaching, mathematics and mathematics learning singly or in combination play an important role in the actualities of the classroom (Thompson, 1984, 1992). The opposite may also be true, in that the events of the classroom and the context for the beginning year may also influence the beliefs held by the beginning teacher. These then, in turn, may influence the pedagogical practice in the classroom. This section will describe instances of practice and other factors influencing beliefs.

## Pedagogical knowledge

Harry, in contrast to Stephanie and Tiffany, had a strongly held image and belief about mathematics and mathematics teaching. This underlying belief had a significant influence on what mathematics he taught in his classroom as well as how he taught mathematics. While, at times, he voiced thoughts about other ways to teach mathematics, rarely did he put these ideas into actual classroom practice. His experience and interpretation of resources, expectations, the children and circumstances all, at one time or another, confirmed his belief and at the same time reinforced it.

For Harry, mathematics meant number and number meant learning the procedures for the four operations and associated content such as fractions and place value. Mathematics had to be realistic and relevant—hence aspects, especially of shape, were missed as being irrelevant and of no use in real life.

The First Term was planned to be a 'number hit'. 'Informal work' in measurement was connected to house plans and working out associated costs. Harry met with problems when the Western Australian Syllabus, and the textbook he followed, offered work on topics in shape, for example, tessellation. Harry noted, “tessellation is a real waste of time. Nice to know but not necessary” (H3). Such topics were postponed, in order to do number or were done in a shallow, rushed way.

Children in his class confirmed him in his beliefs. On one occasion, early in his beginning year, he attempted a 3D-section lesson using plasticine models and cutting sections from the models. This was something very different in style and teaching approach. The children 'played up' and, consequently, Harry was loath to try anything similar as 'these kids can't cope with it'.

Harry saw mathematics in a linear way, as a series of steps to be mastered before moving on to the next one. Mathematics was a collection of procedures and facts that have to be learned, practised and remembered.

Harry's view of mathematics as the replication of procedures generally, made him avoid any activities, which were open in style. These were activities, which required the children to make decisions. Harry felt that he could not 'be open with these kids'.

A combination of the children's reaction to a new way of working, Harry's own unease with open tasks and his need for control and to keep their interest, combined to confirm and justify his avoidance of working in a more open way. He was very dismissive, particularly in the first couple of terms, of ideas that did not match his simplistic, behaviourist, skills-based notion of mathematics. The Student Outcome Statements for Western Australian Schools were described as a 'wiffy waffly load of rubbish'.

Assessment followed the traditional pattern with a summative, pencil and paper test given after a section of teaching. In Harry's case, the test at the end of Term Two covered the whole of the year's syllabus content, and took some of the children two days to complete. Part of the testing process involved the speedy recall of tables, basic facts and the ability to calculate answers to situations mentally. This is a traditional belief of mathematics and mathematics teaching.

By Term Three, however, Harry started to see mathematics from the viewpoint of the learner. Possibly, the change came from the fact that the Year Seven children were no longer part of the mathematics class, having been taken out for their mathematics lessons by the Principal. Harry was, by now, also more confident in his ability to control the class. This combination of factors meant that Harry could move out a little from his 'comfort zone' and start to examine his beliefs in light of his experience of two terms with the children.

Harry, in Term Three, maintained his belief that mathematics should be grounded in real life situations and applications.

Rounding is something the children, through my experience with them last term, have a lot of difficulty with, particularly in mental maths, in being able to just come up with an estimate of how much change they should receive in a shop. I'm hoping by working on their rounding, and improving their rounding skills again to build their confidence in mental maths generally. So we started off the week looking at rounding of whole numbers and then we moved to rounding of decimals. The activities we did looked at rounding in real life as well, which I thought is an essential component of this and exactly what I wanted to do with the children is for them to see the purpose of rounding rather than just thinking "Oh look, this is how you round and these are the rules involved"... (H. Journal 5).

Harry's belief that mathematics was a linear, step-like progression was demonstrated in his practice where everyone did the same thing. However, he also found that the

children and the reality challenged his belief. Some children ‘get it’ easily and move on quickly, whereas others were slower and were being left behind the rest of the class. This situation added to Harry’s difficulties of trying to teach the whole class in the traditional style.

I’m finding the diversity of my class is again becoming a bit of a problem even in doing relatively simple maths such as number patterns and ordering small and large numbers. A number of the children in the class struggle with the concept and particularly in place value with decimals and placing them in order from smallest to largest, even though we’ve done this over and over again, some children just seem to take so long to get the concept, and I’m finding I’m having problems now with some of my children being way ahead and some struggling with concepts. I’m finding myself looking for extra resources now, not only to extend the children but to try and short-cut perhaps the children who are a long way behind so they don’t stay that far behind all the way along (H. Journal 6).

Harry’s belief that mathematics was about being able to calculate using standard methods was further confirmed by his comments on the use of calculators.

H: ...It’s a personal belief of mine. I think the use of calculators is fine, but you must be able to do it without a calculator. I dunno, maybe it’s just to satisfy myself, but I’m not quite comfortable with calculators, because I haven’t come from that background, but I think having both, why not rather than just be able to use a calculator, despite the argument that calculators will always be here, why not be able to do it with pen and paper as well (H7).

Harry acknowledged the presence of such things as calculators, manipulatives and other ways of working in mathematics. Because he had not experienced them during his time as a pupil, he did not see their worth, and would not use them in his teaching. The emphasis placed on these things during his teacher education course, where he actually used them, had no influence on his pedagogical beliefs, and hence his pedagogical practice.

The textbook and number work continued to be the basis of Harry’s classroom practice in mathematics even though he was aware of the shortcomings.

H: I’ve done all solid number. I haven’t done any measurement or space apart from, there was one lesson on spatial awareness where

they had to set out a plan of the school. ...Other than that it has been, I guess in a sense very routine, sort of working out of books, out of the MTS books (H6).

His belief that mathematics was about learning how to calculate was strong and quite resistant to change. Resistant even to the fact that an earlier lesson on spatial awareness was “a good lesson that worked really well and the kids really enjoyed it” (H3).

### The present school context

The Principal's views confirmed many of Harry's beliefs about mathematics and its consequent teaching. He believed in covering the basics first, then going on to problem solving. This was a traditional view of 'learn the technique and then apply it in a context'.

H: The Principal's a bit of a maths and science person, so he's very big on problem solving. What he wants us to do is to go through all the basics first and then do some problem solving (H6).

Problem solving here was again a traditional interpretation, being 'word problems' and the application of the particular learned technique in a real or pseudo-real context, typical of textbooks. The style of work and content expected by the Principal complemented Harry's belief about mathematics. “I've done quite a lot of problem solving and I like it because it is more closer to real maths again than anything else” (H6). Harry did not have an interpretation of problem solving following a generally accepted model of problem solving as involving an unknown solution to a situation that does not involve a set procedure or as an integrated approach with an emphasis on working mathematically.

## Mathematical content knowledge

Aspects of Harry's classroom practice were also governed by belief in his personal ability in mathematics.

H: I'm not good at thinking that way myself, so I don't feel confident in doing that with the kids so much. I'm not wired that way myself yet. I may learn to think more along those lines, but I wouldn't like to write it off and say I won't do it, but I don't want to do it really (H6).

He believed that he was not good at problem solving mathematics and thus, would not make it part of his pedagogical practice. This presented a traditional view that the teacher should have all the knowledge and that teaching was purely about transferring or imparting that knowledge to others. As he was unprepared to 'try it out' and as there were no examples of this style of teaching happening in the school, there was little chance that his beliefs about teaching would be influenced and challenged.

H: ...as long as I can work through it, and there's no worries in that sense. I don't want to get into a situation where I'm teaching something I can't do myself (H6).

H: Yeah, but my fear with some of the stuff is that I won't get it, because I just can't seem to think in that way. Any other maths equation, give me any of the normal sort of maths stuff I can work out, you know (H6).

The school context confirmed Harry's belief about mathematics and mathematics teaching.

H: ...my perception of the school is that it has a really old fashioned approach to maths and that new ideas like working mathematically or even things slightly not clear in the objectives or not specific would be, "Oh well, that's a nice maths game, now let's get on with the real maths". That's the focus I feel in this school. That's my perception, and so I would do this ... if I

programmed it I would have to program it amongst a lot of very serious maths and say, “Well this day we had an easy day” (H6).

It was interesting to note from Harry’s words that he believed that there was ‘serious maths’ or ‘real maths’ and other types of mathematics, which are not really important and you do only if you want ‘an easy day’. Games and puzzles were seen as not mathematics and had to be hidden or disguised as something else in the curriculum. Harry appeared to believe that learning mathematics had to be hard work.

## Summary

Not much changed during the year for Harry. His beliefs about mathematics and, in particular, mathematics teaching remained intact. The school context exerted a strong influence on his beliefs by confirming much of what he thought, and also negating any possible influence from other factors that were present in the general surroundings. The children reacted against his attempt to try a different teaching method from the traditional teacher demonstration and textbook completion method, which again confirmed his beliefs about pedagogical practice. Harry had strong beliefs, which had resisted possible influences such as his teacher education course. His acknowledged lack of experience with problem solving and working mathematically made him reluctant to employ these methods with his class and thus gain positive experience from them.

## Research Question 3

*To what extent is an empowerment model of professional development, with fellow worker support, an effective way to help beginning teachers develop as professional teachers?*

A superficial analysis of the data would suggest that, with Harry, the professional development model had little effect on his classroom practice. Harry’s strongly held beliefs about mathematics and how it should be taught, combined with the pressures of his home life and the classroom, formed a situation where experimentation and reflection were restricted. This section of Chapter Seven will discuss the interaction



of the professional development model with Harry and will consider the effectiveness of its various principles of operation in developing Harry as a professional teacher.

### The professional development support model

The model with its protocols and principles was established with Harry, in fact he was the first to be engaged and was generally first in any cycle of visits.

Harry was keen to put his mathematics work into a context; in his words to make it real and relevant. For him, unless learning could be seen to be useful, it was not worth bothering with in an already crowded syllabus. As was noted earlier, he considered such things as “tessellation (to be) a real waste of time. Nice to know but not necessary” (H3). He realised that tessellation had to be done as it was part of the Western Australian Mathematics Syllabus and was, therefore, searching for a context, a real situation in which to set it.

Using the options approach of the empowerment model, the 'fellow worker' outlined how the content might be given in a realistic setting. One of the options suggested was to place tessellation, symmetry and area tasks in a small project of architecture, where the children would be designing architects and have to respond to the needs of a client. Similar projects have worked well in the past, and had engendered much enthusiasm for children and produced some quality learning. Information about a similar project, background materials and simple tessellation software were supplied by the 'fellow worker'. Harry listened and nodded in apparent agreement. However, this suggestion was badly matched to Harry, his beliefs and his situation. He had a traditional belief about mathematics and really wanted examples of the style ‘A man has to carpet a rectangular room 6m by 4m, how much carpet does he have to buy?’ The option offered something, which was far too open, would take too long and had moved into a style of work unfamiliar to Harry.

What happened in actuality was that Harry received the material and put it on one side for use, later. In fact, he never managed to find time to start the work and it was left unused.

L: Last time we were here we talked about putting things into a context, trying to give them some realistic feel, as much as we could. I think I sent you a whole pile of stuff.

H: I got it. ...I've not put it into practice yet. I'm doing it about Week Seven (H4).

Suggestions were made for using the World Wide Web with the new computers, when they arrived, to support the proposed work. This option was again too far from Harry's thinking, ability and concern and so was not taken forward into classroom practice.

More practical, down-to-earth options were offered using scrap paper to form the tessellation. None of these ways were actually adopted, as Harry found another way and used it in an art lesson. Work with tessellation presented less of a problem of justification for Harry if it was called art rather than mathematics. By doing it this way, as a lesson in art, he was able to reconcile his need to do 'real' mathematics in mathematics time.

The options contained thoughts related to organising such activities in the classroom and the mix of ability, as this was an area of concern for Harry. He listened politely to the options, which were designed to match his thoughts, questions and issues. Situations were used to try to alleviate noted problems, for example, not having equipment and data available or easily and quickly accessed for the lesson.

L: So on Sunday afternoon or eleven o'clock Sunday night or five o'clock Monday morning you're saying, "Well look I want to do time. Wood and Lowther do this. Well what options do you have? Leave it till the end of the week? Some nice stuff I saw from Inner London was a project called *Impact* and homework type tasks were getting the kids to generate the data. So your homework tonight or before Thursday is ...(H4).

It appeared that, particularly in the early terms, whatever options were suggested were not put into pedagogical practice in the classroom.

H: I can't be bothered with open maths with Year Sevens any more. It's just not worth it. I get too tired, I've got you know, it's too much work (H4).

A combination of personal beliefs, the context of the children, personal ability and lack of time allowed Harry to justify his approach and to resist all options and even a small amount of change. Harry's view on openness and the ability of these children, was a main barrier to change. By the end of Term Two, however, suggestions for using open situations were not working and future options offered from the 'fellow worker' acknowledged this impasse. A slightly different style of options was suggested, which involved more direct teacher input.

L: Can you start to be, this is almost contradictory, more teacher directed? I've got a nice little model which uses time and teacher direction. You start by being more teacher directed. So you tell them, we're multiplying this one and you've got two minutes to devise how you are going to do it. Then tell me how you are going to collect the data and what you are going to use. So you are actually structuring it. Gradually you reduce the amount of structure (H4).

The issue of range of age and ability was tackled within a context of number. As Harry was now more confident in his ability to control and manage the children, it was suggested that he might experiment. An underlying view was that he would then enter one of the phases for change identified by Clarke and Peter (1991), that is, experimentation. An example from later in the year was that of integration. Integration in this context refers to using problem solving as a teaching style for the learning of mathematical content. That is, problem solving is not a separate lesson or something that is done away from learning mathematics.

L: So there's an integrated model of problem solving.

H: We could do that, that would be really good thing to do, they'd enjoy it

L: ...It might be interesting to see what reaction they have.

H: I'll give it a go (H7).

Another way in which the professional development model attempted to support teacher thinking was to relate mathematics teaching to styles of teaching in other subject areas, for example, language. In this way the beginning teacher was encouraged to re-evaluate classroom practice.

L: She [a teacher on an assessment CD-ROM known to Harry] also uses the idea of journals. It seemed to be a big thing. Tell me three things you know about fractions, what you have to do, something you want to know about, what questions you have about fractions. Try to get the kids to write and think about mathematics (H7).

L: Thinking about your kids and word problems, then I've got twenty-six ways to help kids understand word problems, which are based on language techniques.

H: I could use that right now (H7).

Most of the offering of options to use, that is, direct suggestions from the 'fellow worker', came in the early terms of the beginning year. These were only partially successful with Harry. In the last two terms, the approach was much more one of encouraging the beginning teacher to reflect on and think about critical incidents in the classroom. From this situation options and clarifications were generated by the beginning teacher. This was a subtle move, from a dependency model to one of self-sufficiency. A move that would have to happen, in the next year, if the beginning teacher was to develop aspects of professionalism, in the absence of the fellow worker.

### The action research model

This aspect of the model appeared to have little or no effect on Harry's development and pedagogical practice. The cycles of plan, act, observe and evaluate were not successful. Generally, Harry was so engrossed with driving children through the

syllabus content that he had no time to try something else. Some of the options for actions were also outside his belief about mathematics teaching.

The first problem area identified, for action in the cycle, was that of relevance of the space component of the syllabus. Suggestions were made for embedding and applying aspects of space and these were sent to Harry. Options for action were also described during interviews. Nothing happened in the classroom, and hence there was no evidence of action to observe and to evaluate ready for the next cycle of the action research model. No other action research cycles were attempted.

Later, Harry noted in his journal that the class had done some work on tessellation. Harry had used one small aspect of the options suggested, and had used the environment to stimulate work and provide examples of tessellation occurring. He noted that this had been successful and, for many of the children, a novel experience.

Other aspects of the professional development model were preferred and emphasised during the year, as they seemed more appropriate to Harry and his context, and these were adopted.

### Encouraging teacher reflection

As the year progressed the role of the professional development model moved away from purely offering options for practice, to one of encouraging reflection on practice by the teacher. This next part of the discussion will consider that process in action with Harry and be followed by an analysis of his actual reflections. The notion of reflection-on-practice was seen as the precursor to a professional strategy of reflection-in-practice, whereby the teacher makes considered, rational decisions while in the process of teaching rather than after the teaching has taken place.

Each time the fellow worker encouraged reflection it was grounded in Harry's classroom practice and with his children. This was a replication of what would have to happen when the 'fellow worker' left at the end of the year.

L: Whenever I've worked with tessellation and that sort of Escher slant with kids they've enjoyed it. The hard bit is getting the mathematics out of it. It's easy to do the colouring in. Okay so if

that's coming up, the little that you've probably thought about for the moment, is there anything else that you have noticed that you think will be difficult or that you will need help with? (H4).

L: How do you think they might become, what was your word, wired? (H6).

With Harry, general reflective questions were asked throughout the year to encourage him to see success in situations and for the development of teaching technique. Examples offered below illustrate those relevant to Harry.

L: So how do you think you're a different teacher now that you are into your second term? (H4).

L: ...How are you different? What sort of things might you be doing now that either you couldn't do then or you hadn't thought of then? (H6).

L: If you think back over the year as far as you've gone, is there a particular incident, a particular happening that's had a sort of direct bearing on what you've been doing in mathematics? (H7).

Problems associated with teaching three grades were always to the forefront of Harry's mind. Often the question, which encouraged reflection, was aimed at an option for resolution of the problem.

L: Are there some things that you can give to the Fives, Sixes and Sevens? Is there something you can do with all of them?

L: Not in the sense that they all do exactly the same thing, the same piece of adding (H4).

General comments made by Harry were questioned, by asking him to clarify what he meant by them. From reflection on the meaning of the comments and being explicit about their detail, possible solutions to his problems could be discussed.

L: You said you worked more individually. Does that mean you are able to talk more one-to-one?

L: Does it mean that you have an individualised program? (H6).

L: Go back to the map thing. What made it good? (H6).

L: What do you mean or what is he [the Principal] meaning by problem solving? (H6).

On occasions, tentative options were given for Harry to consider and reflect upon.

L: So what about things like the problem solving where there isn't necessarily a technique or formula to use? Something that might be much more open-ended and can go anywhere it likes (H6).

With Harry, skills of situational analysis were encouraged, so that he could begin to see how issues were similar to but also different from others he had met. This was particularly useful as the year progressed, and Harry had more experience with which to compare. On occasions, the school context affected Harry's work.

L: So if you were not doing that, say you hadn't been told from on high to do this, what would you do? (H6).

Encouragement to reflect was added to keep Harry open to thinking about other ways to do the same thing, with the possibility later, of experimenting and evaluating the effectiveness of the strategy. As Harry grew in confidence in managing the class and became more settled into his maths teaching, it became more appropriate to have him reflect more closely on his actual teaching. Through this method, he was encouraged to consider the wider implications of his decisions.

L: So it seems to be working in that the good kids help the not-so-good-kids. But what help do the good kids get? (H7).

L: Why do you have or why do you feel you have the time to do it in language, where you don't have time to do it in maths? (H8).

The next section will consider Harry's actual reflections. It will also discuss how these reflections changed during the year.

## Teacher reflection

Harry's reflection on his pedagogical practice generally developed throughout the year. Initially, he was too busy surviving to find time to think very deeply about what he was doing. Most of Harry's reflecting happened during the last two terms of his beginning year. This also coincided, as noted earlier, with a change of emphasis in the role of the 'fellow worker'.

By the end of Term Two, Harry was more confident in his ability to manage the class. Control was not a predominant issue at this point. He now had time to start to think about what was actually happening in the classroom and how it might be changed. He began to consider some of the barriers to doing the sort of mathematics that he wished.

H: And we worked really well. And I thought this is how I'm going to do it. Rather just, that's why I rushed through so much maths last term. I should have spent longer on each thing and expanded it, rather than just going boom ...(H4).

The mixed ability and cross-age grouping problem was often considered. From this consideration, possible solutions began to emerge.

H: I just modified both teaching areas into one. Like making a concept in a social studies program ...enough in it for all of them to get what they need out of it and more (H4).

This appeared to be a more effective change agent than being told what to do by another person, and, in Harry's case, more effective at this time than the options for development offered by the 'fellow worker'.

He started, by Term Three, to become more critical and insightful into his practice; into things that often were taken-for-granted and unquestioned.



H: Well it's a bit, I mean to me in my mind I'd be bored with it. Unless you are really into competing with your partner, which suits the Year Sevens. It's fine because they love to compete. ...but otherwise it doesn't really mean anything (H6).

He was now beginning to work with the actual children he had in the classroom rather than a possibly idealised notion of children and mathematics learning. As he became more aware of the children's ability, he was able to consider ways in which his teaching might develop and change, to overcome the identified difficulties.

H:...I think it's a weakness [ability in general problem solving], like it's picked up in tests, we just don't spend enough time in other kinds of maths (H7).

It seemed that, in Harry's case, the reflecting might not have happened if there had not been the stimulus or catalyst of the 'fellow worker' available. Some forms of reflecting resulted from the prompts or probes of the visitor, as discussed earlier.

H: ...I will probably be looking at, if it's possible to group kids in a system, like you do with language, reading groups and stuff, but grouping them with maths groups. Working again within my themes ...either different levels of work or different expectations. But I dunno, I'm still thinking about it (H6).

By the end of the Year, Harry was beginning to reflect on ideas and teaching strategies, and planning how he might incorporate them into his overall pedagogical practice for the next year.

Harry found the project to be useful as part of his mathematics teaching development. The visits by the 'fellow worker' gently forced the issue of reflection and helped him think about his teaching.

H: First off it [the fellow worker visits] has been useful. Yes it's been useful, and the main reason is as a sounding board. Because by talking to you about what I'm doing, when talking to you about what I'm doing gives me a sounding board so I can reflect on

what I've done and I can, in explaining what I do just re-clarify in my mind where I'm going. Secondly for the ideas. You've had a lot of useful ideas, good ideas and challenged me a little bit in thinking about maths. If you hadn't come I might have been a lot more narrow in thinking about maths. I certainly wouldn't have been challenged to think of different ideas, different ways of doing things. Even if I hadn't applied all that you told me about, I will one day, or could one day (H8).

L: What have I told you?

H: You've given me a lot of good ideas. I mean I ...for a while I was heading down the road of becoming a bit of a worksheet guru ...probably at that time I was finding it really difficult to teach, half way through third term it was really crushing me, and it was starting to unwind maths-wise ...letting it go and facing other areas and then you sort of give me ...in talking to you it was like a kick in the butt, you know like, "Hang on a sec, wake up, what are you doing"?

L: But I haven't been kicking your butt.

H: No, but for me I want to be a very good teacher, that's the thing, I don't want to be slack, and if I'd seen what I was doing, if you hadn't, if I hadn't been talking to you I might not have picked up as quickly as I did, but I was getting a bit slack. When I say slack I don't want to become what I've seen in the classroom on prac. Where the guy just opens up the book and hasn't even checked the night before and says "Do such and such a page". That's not what I want to be. You know I was heading down that way. I don't want to be that way. But you burst the bubble a little bit with that so that I sort of woke up to it, you know maths lends itself a little bit that way, having a pre-prepared text, out of all the subjects it's one of the easiest ones to be slack on, and I don't

want to be and didn't intend to be but my focus was elsewhere (H8).

The professional development model had been useful to Harry, to set him thinking about his pedagogical practice, and to support him in making thoughtful changes and developments. The next section will consider those changes to classroom practice in mathematics teaching.

## Change in classroom practice

It what ways, if any, did Harry's classroom practice in mathematics teaching change over his first year of teaching? Did the use of the empowerment model support, maintain or cause the change? This next section will discuss these two questions, and use evidence from interviews, Harry's journal and the Case methods meeting to illustrate and describe points of interest.

Initially Harry's pedagogical practice was traditional, with an emphasis on the completion of tasks involving number. All three grades were 'doing a number bit', with a little work in space and measurement. Generally, this was teacher-directed, procedural learning. Mental mathematics was speedy recall of tables facts and number bonds. The textbook series West Australian Mathematics was the core of his planning and the children's work. A directive had come from the Principal to 'hit numbers hard', especially place value. He talked of setting the work in context and making it real. Thus, anything that he could not set in a context Harry avoided, skimmed over or rushed. Examples he mentioned were tessellation and symmetry as 'a real waste of time because they are not practical'. As they could not be used in real life, in his opinion, there was no reason for doing them.

The start of change began towards the end of Term Two. Harry now was less anxious about management and control of the children and the classroom. He had covered the syllabus in number, and was beginning to think about his classroom actions. The visit of the 'fellow worker' as part of the project acted as a catalyst and a reason for the reflection-on-practice to take place.

Harry now started to consider the children, rather than concentrate on the speed of delivery of material, in an attempt to cover everything in the syllabus. Previously

Harry thought children would learn some aspect of mathematics if they completed one page of their mathematics textbook or a worksheet on the idea. Thus, children would proceed through the textbook series completing pages, which along with a regular pencil and paper test would be assumed to constitute learning. Those children who were slow workers or unsure of the idea were taken to the next page with incomplete work and knowledge. From the end of Term Two, he began to work with a series of lessons or activities related to the same idea. In addition, he considered the needs of the less able members of the class by offering them more of his attention.

Assessment, at the end of Term Two, was being used to find out what the children could do and what they understood. Aspects from this evidence of learning began to inform his planning and teaching in Term Three. Assessment became a little broader to include keeping of work samples to form a portfolio of work for each child. It took on a form other than the end of unit pencil and paper test. The test, however, remained the major method for assessment.

Speed of coverage of material was still a main concern for Harry. He felt that he needed to ensure that all the syllabus material for number had been covered, so that he could be judged as a good teacher. By Term Three, however, he started to reflect on this and reconsidered his stance, as his journal noted.

An important thing I learned through Term Two and coming into Term Three was that I had probably gone a little bit too fast in trying to cover the material in the syllabus. Each grade now has well and truly covered everything there is in the maths syllabus, and the one main thing I've learned, probably through the year actually, is that it's OK to slow down, to take my time and spend more time on each concept, and that's what I'll be doing in Term Three and Four reviewing the whole syllabus, expanding where necessary and where possible for those children that really have learned well, but for the other children that perhaps I've gone a little fast for, although they seem to have a fairly good grasp of it, I'll be going over a lot more slowly with a lot less pressure (H. Journal 1).

The holiday between Term Two and Term Three appeared to be a watershed for Harry. It was also the time when the Principal took off the Year Seven children, leaving Harry with about sixteen Year Five and Year Six children. Harry was released from the pressures and competition exerted by the Year Seven children, as well as the difficulties of managing a large number of children across three age ranges as well as ability ranges. He was able, with smaller numbers of children, to consider and attend

to the individual needs of children. There was a shift from teaching everyone the same idea and ignoring most of the differences and difficulties of the class, to still working in the same mathematical area, but attending more to the needs of the slower learners.

So far I'm really enjoying having the extra time with the children. It's a totally different atmosphere to what it was like when they had the Year Sevens in here as well. There seems to be plenty of time to cater for the individual needs and I'm getting round to all those children that need that extra bit of help and encouragement, and it seems to be working well (H. Journal 4).

H: I don't have an individualised program but I could tell you a child's strengths and weaknesses and could tell you where they're at with maths. I know them well enough to do that (H6).

He also began to learn from the children, to find out what was going well and what was failing. This again emphasised for him the folly of his speed of coverage approach that he had adopted earlier.

By the middle to end of Term Three, he was beginning to draw on his experiences to solve problems occurring in the classroom. For example, experiences in his University course teaching practice were used to provide a possible solution to his marking problem. Already, Harry was becoming a more thoughtful and reflective teacher.

What I've designed is a system, or the system I'm using is one that I learned from the Year Six/Seven teacher on one of my pracs when I was at Uni, and it's one where there are only two or three copies, or actually three copies each of the marking sheets and so that only a small number of children at any one time can be marking and we're just sort of rotating this around. With only a small number of children at any one time marking I'm able to observe them more readily and make spot checks to make sure they are not cheating. Thus far the children seem to be enjoying it more. They seem to appreciate that they've got the responsibility and it's saving us a lot of time, which is working well (H. Journal 4).

Gradually, he was releasing some of the control of the classroom happenings to the children and finding that they were able to take and accept such a responsibility. Control of learning and the mathematics, however, was still with Harry.

He was also more critical and aware of, not only what he was doing, but also what the textbook, in this case *Maths Today Series* (MTS), was doing. Previously there had

been an almost blind adherence to the textbook that he found in the school (*West Australian Mathematics*).

The only thing of interest that I've found is while MTS supports the rule, not all of their questions, not all of the problems they present to the children follow the rule. This tends to be a little bit confusing to the children and frustrating to me (H. Journal 7).

The routine of working out of textbooks was still the general methodology, even in Term Three. There were, however, small excursions with other styles of teaching.

H: I've been doing ...I've done solid number, I haven't done any space or measurement apart from, there was one lesson on spatial awareness where they had to set out a plan of the school. ...This was quite a good lesson. It worked well. The kids really enjoyed it. ...Other than that it has been, I guess in a sense very routine, sort of work out of books, out of the MTS books (H6).

The excursions, however, were in non-number content areas. Although they were successful, they did not make any significant inroads into his predominant, textbook teaching style for number.

By the end of Term Three, Harry talked about mental mathematics in a different way. He began to mention children using different strategies to obtain the answer and possibly most significantly, in terms of change of practice, that the discussion of these different strategies formed part of his lesson.

H: That's how we work with the kids individually with mental maths. Looking at different strategies and ways of getting the same answer. I find some kids, you would know this, don't all think alike, but that in some ways have come to a solution more suitable to one child than another. You know you, talk to them and say this is how I'd do it, and this is another way and this is another way, and it's amazing the range of ways that they prefer to work things out (H6).

This appeared to be a change in emphasis from one of purely speed recall with the answer being paramount. A variation in procedure in obtaining the answer was now

sanctioned in aspects of mathematics. For Harry, this was a significant change in practice. He was now allowing the children more say in what they did and the procedure they used to find the answer. Harry began to loosen his grip on his previous teacher-dominated, procedural pedagogy in mathematics.

The end of Term Three was also the time for Harry's evaluation by the Principal. On the positive result of this assessment hung Harry's full-time teaching appointment at the school for the next year, and his acceptance into the Independent Sector of teaching. When this was out of the way, Harry noted that he had stopped 'driving the kids and the mathematics coverage' and himself as well and had become less fretful. His belief about teaching also started to change.

H: So I sat back and was talking to the Principal about it and one of the other teachers. They said my expectations were too high on myself over what I'm going to achieve in a year. So now I've tried to make it more individual and I keep a lot more detailed notes on where each child is at. They've all got to improve, that's my standard now. I'm putting that on me not on them. I will feel like I've succeeded if I've got them to improve, rather than say you know I've got them to Year Five standard when they're ... they've come to me in Year Three you know. Whereas the kids that are capable, then I'm sure I'm going to take them as far as I can take them, but the kids that have got definite learning disorders or disabilities or for whatever reason are struggling cause there are things I can't do anything about, home things or whatever (H6).

He felt that he no longer had to prove himself, no longer had to establish himself in the eyes of others as a good teacher by 'getting through vast amounts of mathematics' with children.

H: It's a confidence thing too. I feel better able to defend myself now. Like before it was almost like "A new teacher, everyone's watching, everyone's waiting for me to fail". ...like feeling confidence to say, "Hey this is what I'm doing", rather than

saying this is what I'm doing with someone criticising and then saying alright I'll change it. Now I feel more confident, I say, "Well this is what I'm doing and this is why I'm doing it..."(H6).

Children and their compatibilities were now the focus of attention. Harry had more confidence and was able to 'see the children', much in the same way Stephanie and Tiffany changed. The style of pedagogy, by the end of Term Three, had changed from that of Terms One and Two.

H: ...I've got them working more independently than they were before too. So that they have their set work and I just rotate around the whole time they are working. I get them started on a theme at the beginning of the week. ...If they finish early I've got extension material and if they're going too slow then I'm with them and we work on what's missing, how to catch up, do this, do this. So that at the end of that two week period they've all covered what I want them to cover, more thoroughly or slightly less thoroughly depending on their ability level. ...They know what they have to do, the tasks that are ahead and they do a bit each day and I just move around (H7).

Change here was due to a large extent to the reduced number of children in the class for mathematics, and on the easing of limitations set by children's attitudes to mathematics with the removal of the Year Seven children. This was a very different situation compared to the earlier classroom atmosphere, when it contained the vociferous group of Year Seven children. A further factor in the change was Harry's realisation that coverage per se was not the main quality teaching factor in mathematics. Pedagogical practice, however, did not change to incorporate group work and co-operative work in mathematics.

Mathematics teaching was seen as different from other subject area teaching. Grouping and co-operative work was acceptable and successful in these areas. Somehow, however, Harry considered mathematics teaching to be different, and in need of another style of pedagogy. Harry's traditional beliefs about mathematics and



mathematics teaching were still a strong influence on pedagogical practice and made him resistant to change.

## Summary

The influence of the professional development model on Harry's classroom practice in mathematics teaching was limited. His strong beliefs about what constituted mathematics teaching largely acted as a barrier to change. The support and active reflection on practice that was offered by the professional development model eventually allowed him the chance to think about what was happening in his classroom. This aspect was especially important when he had managed to 'survive' and was beginning to think about what the children were doing. The model established a situation where he was able to reflect. This reflection may not have happened if the 'fellow worker' had not visited as part of the cycle of meetings. There was also considerable assistance in this reflection by the reduction in the number of children in the class for mathematics. In that sense the empowerment model of professional development was effective in helping Harry start to act as a professional, reflective teacher of mathematics. He still, however, had much to do to acknowledge the strong influences of his beliefs about mathematics and the traditional emphasis of the school and the Principal.

## Chapter 8

### **Case study analysis and discussion**

This last case study chapter, in fact two brief studies, involving Gaz and Patrick will be different from the others. Both came to teaching at a slightly older age and, while initially enthusiastic and committed to this project, ultimately did not complete a full year with it. Gaz officially withdrew from the study by letter in the middle of Term Three; Patrick took no active part in the project from the middle of Term Two. The data, therefore, for both participants are brief and incomplete. The case study is included as it adds other perspectives to information on the ‘survival’ of the beginning year of teaching.

### **Case Study – Gaz and Patrick**

#### **Setting and background**

##### **Gaz**

Gaz initially trained to be a high school teacher and gained a B.A (Ed). After a short time teaching, he decided to withdraw from the school and retrain as a primary school teacher via a Graduate Diploma in Primary Education course. His specialisms during his initial degree were History, English and Computing.

During his Graduate Diploma year, Gaz established contact with a primary school and continued to teach there with university agreement during his course for the equivalent of two days a week. His teaching experience with the teacher education course was, therefore, different from the other three case studies described here. Gaz was already a qualified teacher and was exempt from the Assistant Teacher Placement final practice.

Gaz secured a full-time job at the school where he was working during the Diploma course. Thus, as he started his first year of primary teaching, he had had some experience of the school, the staff and the children. This was a different beginning to the other people in this study and untypical of the experience of most beginning teachers. The school was a large metropolitan primary school, built mainly in the nineteen fifties and sixties. The classrooms and administrative buildings were of brick and placed in clusters around the school grounds. Gaz's classroom seemed slightly more modern and had a door to the outside area. Inside it was semi-open plan in layout with areas, which flowed into each other and into other teacher's areas. The school served generally a low socio-economic area.

Staffing for the school consisted of a Principal plus seven full-time classroom teachers with three specialist teachers. To this were added part-time teachers without responsibility for a specific class and other ancillary staff, including a psychiatrist. Within the staff, there was a range of experience and age.

Gaz's first class of primary children was a mixed grade of children from Year Two and Year Three. The class had a wide range of ability, which, like the classes of the other cases of this study, enlarged the problem of dealing with the ability gap. Some of the children had behaviour and social problems; for example, one Year Two child was suspended from the school for 12 days out of the first four weeks of the year. The same child, Gaz discovered later, could not read or write.

## **Patrick**

Patrick was aged thirty when he began work with his Year Five class. Earlier (1988-92) he had gained a BA degree in Commerce and Communications. Between 1992 and 1996 he had been a commercial house painter. His teacher education was of the same format as Stephanie and Tiffany, in that he undertook a one year long, Graduate Diploma in Primary education.

Patrick was employed in a teaching position within the Catholic Independent System well before Christmas at the end of his training year. Thus, unlike Stephanie and Tiffany, he had quite a time to plan and adjust to his following year situation before he had to work with the children.

The school, situated in a large town about an hour's drive to the south of Perth, was modern in appearance having been built within the previous ten years. The school had a full primary age range with approximately 350 children. A range of part-time staff and full-time specialist teachers supported the teaching staff. Patrick worked with a class of twenty-five, mixed ability, Year Five children. He was, in this sense, unlike other members of the project group in that he did not have more than one-year group within his class as well as a relatively small number of children in his class. The children came from mainly home-owning, middle class parents who formed the bulk of adults in the new housing area surrounding the school.

### Withdrawal from the study

Working on the study with Patrick proved to be difficult. Initially, he was very enthusiastic and volunteered for consideration when the idea of the project was raised towards the end of his year of training. The first meeting went smoothly and Patrick offered useful comments in relation to questions, the next meeting date was established and the tasks clarified. A later letter of confirmation of these details was sent, as this was the general practice of the project. The actual meeting was curtailed, as Patrick had to attend the regular monthly staff meeting. He had not done any of the tasks he had agreed to undertake. The date of the next meeting was established and confirmed in a similar fashion. On this occasion, Patrick had to dash away to coach the soccer team, and after the practice, retrieve his car from the local garage where it was being serviced. Two further meetings were scheduled, and confirmed by telephone, but as no return message came as requested, the researcher wrote to Patrick to release him from his commitment to the study.

Gaz presented a similar but, in some respects, slightly different case. In a similar way, Gaz was enthusiastic about the study and entered it with gusto. He produced a lengthy and amusing taped journal for the first term and a half, undertook tasks in the classroom and chatted at the arranged meetings.

Towards the end of Term Two, and especially at the start of Term Three, things changed. He cancelled a meeting at the last moment, was not ready for another and completely forgot two more. He was entering the school car park immediately after school on his way home on one of these occasions. For Gaz this was a crisis time. He was about to be married, his car was stolen and his home vandalised within a month. He was due to be appraised by the Principal; the timing of the appraisal meeting was advanced at Gaz's request to the third term, rather than the more usual fourth term, and this also added to the pressures he felt. Towards the middle of Term Three he wrote withdrawing from the project due to pressure of work.

The next sections will describe and analyse each of the research questions in light of evidence from the limited data available. The majority of the discussion will concentrate on the case of Gaz, as there are more data available for him.

**Research Question 1**

*To what extent do the following factors influence the pedagogical practices of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's reactions and behaviour;
- the beginning teacher's education;
- professional development;

- beliefs about mathematics and mathematics teaching and learning;
- the researcher; and
- other sources.

From the very limited data available, it was difficult to identify, with any certainty, factors that influenced the way Gaz and Patrick taught mathematics. For Gaz, however, the children in his classroom were a major constraining factor, and therefore, a huge influence on how he taught.

## Gaz

### Children's reactions and behaviour

For the first two terms of his beginning teaching year, Gaz maintained a taped journal of his reflections. At the end of each week, he commented on happenings, usually successes, in his classroom. His journal was a record of his struggle to deal with the behaviour, wide ability range and the low level of literacy skills of many of his class members. It contained his reflections and comments on dilemmas he faced, and the challenges to his thoughts and beliefs about teaching mathematics.

Gaz's first entry with his journal presented a picture of the scene before him and what he would have to overcome during his first year of teaching.

[T]he most striking thing I can think of at the end of my first week, ah, being week ending Friday 14th February, is that behaviour in this class is absolutely shocking. I really didn't wanna do it and it's the only entry I will do it in, that I'll focus on behaviour. I've got one kid, 'E'. I can see his name's gonna come up all the time, 'E', it's the only way I can say, he's feral. Um, there's no other word for it. He can't sit still, he can't actually write um, doesn't know how to write the alphabet letters, form the letters, so he can't read either. Um, he'll get up and just walk out, I've had him uh, wee in the corner of the classroom now, he jumps on the desks, for me and my lack of experience, he is what I, just impossible to teach. Um, I've got another kid 'D', now 'D's aged 9, so Year 4, in a Year 2 class. I think that, that speaks for itself as far as, as far as 'D's concerned. He doesn't turn up to school, he'll probably turn up two days a week as such, and he just can't, you can't learn that way, you can't keep moving forward. 'P', a little Aboriginal girl, is, she really threw me, I thought she was thick as two bricks, and orally, orally she is as good as anyone. Um, you give her twenty blocks and say, okay 'P', what's, what's 13 plus 6, you know, she'll get out a pile of 13, she'll get out a pile of 6, and she'll look at you and say "Mr.

Moore, that's 19". But if you put that up on the board, 13 plus 6, she sits there, she can't read it I guess is the word, but orally, amazing, she's thrown me actually. I've got a little Cambodian girl, 'M'. Um, I actually haven't got M to speak to me yet, uh, she will talk to me through her friends but won't actually speak to me. Um, help! These kids are so frustrated that they're not succeeding. Um, and as such they just muck up as their scapegoat out. Because their behaviour is a joke, because I've got kids who can't succeed, I've got kids who can't write, I've got kids who, who can't write but really really want to do it, um in the case of 'P', plus you've got your mainstream kids that are just plain lazy. I find that I can't cope in a scenario like this. Obviously teaching the one lesson, there it is, because you either do it at such a baby level that your upper kids can't do it, or you do it at such a level that the 'E's and the 'P's and the 'D's just sit there and go, "What are you doing, what are you talking about, you're an idiot" (G. Journal 1).

His class contained a mixed-year group (Year 2 and 3 children), and children who could not read or write the simplest things. In addition, there was a Year Four child, a Cambodian child, who would not speak and had very limited English, and a child who had not learned the social ways of behaving in school.

The situation that confronted him threw into question his thoughts about mathematics teaching, went beyond his experiences of the mathematics classroom and presented a problem for which he had no immediate pedagogical answers. He was deeply shocked, mathematics seemed irrelevant compared to trying to make sense of the social environment of the classroom. Thus, the behaviour and reaction of the children would govern whatever he did. The influence of the children was a complex, and interrelated, factor and will be discussed within many of the following sections. The next section will consider how Gaz used his limited knowledge of teaching to develop his pedagogical practice and to overcome the problems that faced him.

## Pedagogical knowledge

Gaz's experience and ideas of teaching mathematics were limited to a traditional approach of textbooks, worksheets and teaching the children a procedure or method to be remembered and later applied. Now, he had a class with quite a large range of ability, both in a mathematical and in a general sense. His methods did not work for many of the children, as these methods required the children to be able to read and write.

From the success he saw when he tried other non-traditional methods of teaching, for example, simple game playing, he gained enough confidence to develop these methods and techniques. He began, with the help of another teacher, to organise and manage the classroom, so that he could spend more time interacting with individuals and small groups of children.

Gaz also moved from a traditional teacher-directed approach to ways of recording by the children that did not involve large amounts of writing. 'Cut and paste' recording of work by the children, and oral accounts became more prominent in his pedagogical practice. Game playing became a regular feature for each Thursday and Gaz's practice accommodated this change. The change in practice came from the discussions Gaz had with the 'fellow worker', the other teacher and from his thinking about what was happening in the classroom. He was less confident and experienced in using these approaches. He did know about them and was prepared to try them in his bid to survive in the initial weeks of his teaching.

In Gaz's case, the children, by their limited ability and mixed ability, forced him to consider and, ultimately, change his teaching practice. From the successes, he noted in their learning, the children also confirmed and consolidated his new approach. While his pedagogical knowledge, in many ways, was limited, he did have an awareness of other techniques, beyond teacher direction and transmission of facts. This knowledge allowed him to think of and employ other non-traditional teaching methods for mathematics. He reacted differently to Harry, for example, in that he did not retreat into a more traditional pedagogy to survive the class. He was prepared to try other ways of teaching, possibly because he realised quickly that it was not possible to work with these children in ways that required a level of literacy that they did not possess.

### The present school context

The school exerted some influence on his pedagogical practice. Gaz met with the Principal every two weeks, which provided support for his teaching. It also presented him with a concern regarding accountability. If children played games and presented their work orally rather than in written form, he would have nothing concrete to show the



Principal as evidence for what he and they had achieved. The Principal did help Gaz overcome his fear of having nothing to show from a traditional teaching standpoint. He suggested that it was important to have the children working and learning and there were a number of appropriate ways to show this other than a traditional pedagogy. This support role from the Principal was important to give validity to Gaz and his new methods of teaching.

The Principal also provided a good model of teaching for Gaz. From an example lesson presented by the Principal, Gaz realised how the same material and learning could be presented in a different and more effective way.

Calculators. Interesting lesson. I'm gonna say a good lesson, and a bad lesson all at once. It was a bad lesson because I believe, or I believed at the time, that Year 2/3 were not able to use a calculator. That they would not comprehend that you press a button, the number appears on the screen, you press the add function, the, another number, the equals and it's gonna give you an answer. I thought that was above their heads, and I was really really worried, and I'd be wasting my time. I pre-judged them, I pre-judged them negatively, the lesson was a flop. I actually had the principal walking past and he said that I was talking to these kids like they were idiots. Like I didn't expect them to have a clue what I was talking about. He did the lesson again, the exact same lesson. He stopped it, got them on the mat, called oh, made fun of me in, in a nice way um, and he did the exact lesson off the lesson plan I did. And it was a huge success. I pre-judged them, I didn't think they would cope. They didn't cope, the Principal, pre-judged them, thought they would cope, raised them, brought them to the occasion and they did cope (G. Journal 10).

Other teachers within the school also provided support for Gaz's teaching development. Specialised teachers removed some of the children with the worst behaviour, an ESL teacher worked with the non-English speaking children and, at times, other support and aide teachers were in the class. This support allowed Gaz to try out different ways of working without the full, possibly negating, influence of the presence of all the children. He was also receiving more support than just the removal of children from the class. He received positive suggestions for what to do and how to do it. This was a very different experience of induction to that received by the other case study teachers.

Then I hooked up with a lady called A. She's an ESL teacher at the school. And she suggested that it's actually, you know, great that you've got all this tape and you've got bits written on and all that sort of stuff. If you were to put that together into a skeleton as such, the tape would just roll and you wouldn't be able to see anything. However, what she suggested to do is grab

some straws from the science room, or some sticks, whatever. Um, grab a bit of balloons and actually make the structure or framework of the skeleton so you tip or stick the straws onto the legs so they actually can't move, and then you, you make the join where the knee goes. Um, and suddenly you've got these actual skeletons that look like skeletons so you've got a piece of straw in the tape that's got the length of the foot going out as a foot so it's tape won't curl 'cause it can't curl with the straw there. Um, a claim to fame (excuse me) the head we measured, oh sorry I didn't worry about the length of the head, we worried about the thickness of the head, um and used a balloon. Blew up the balloon to go inside the tape, whack, there's your head. Um, I can honestly say it was my best lesson so far (G. Journal 4).

The teachers not only supported Gaz, in the sense of offering practical suggestions for his classroom practice, they were by association agreeing with and condoning his pedagogical practice. Some of his concern about whether or not he should be doing this sort of thing, rather than textbook work, was lessened by their involvement.

I've got an aide, a support that comes in during this time, ah - C, and we've actually got the kids working now on three games that they know completely and they can play without our support (G. Journal 5).

The support from the school, in the form of an extra pair of experienced hands, not only allowed Gaz to try different pedagogical styles, but also to see the children in a more positive light. At this time, he noticed their achievements, rather than their failures.

### Time constraints

The issue of coverage of the syllabus, led to a problem with the amount of time needed to undertake activities. Gaz commented that the children were working successfully with the game playing and cut-and-stick techniques. They did take a long time, however, to start and complete the task. In fact, he suggested, it took so much longer for them to work in this way and that, if syllabus coverage was needed, another faster style of work would need to be employed. He had a similar feeling to the other case studies in this project, in that he felt he must 'get the children through' the syllabus content for their year level. He soon realised that he would not be able to do this, due to the low base level of knowledge of many of the children in his class, and he began to look for alternative ways of working. There was, however, still a feeling that syllabus coverage was how he would be judged by the Principal and his colleagues.

There was one huge, huge, huge drawback, I allowed two lessons for it, um, so what's that? I allowed an hour and a half, give and take for it, uh, it took up probably the best part of five hours. Um, I don't know whether that's justifiable, in my opinion I justified it in the sense that I had a whole classroom with the exception of three kids who could actually cooperate, and the kids at B have a hard time cooperating, and this was just a fair dinkum blow out. E and D couldn't cope, and um they dragged a guy J who doesn't normally, but they dragged someone else with them which is unfortunate. Um, very, very, cool lesson, but admittedly, it took far too long. I wonder who I have to justify that extra time to, um, because if it was just me, I can do it, but how can you record, you know, it was worth giving up your Social Studies for that week and it was worth giving up your Health lesson for that week. I can see it but I can't record, I had difficulty trying to record that. Not that anyone questioned it, but you know, you think about accountability and that's the way things go. I had difficulty saying, oh yes it was worth it because of this, this, this, apart from writing down, hey yeah, well these kids co-operated and, let's face it, he won't co-operate with, you know, your child won't co-operate with his brother at home will he? (G. Journal 4).

Time was a factor concerning planning and presentation of lessons. Initially, it appeared that Gaz was writing full lesson plans, as was the requirement for University teaching practice. Some of these were described in full in his journal. He was clear about the objectives for the lessons and had spent considerable time thinking about what was to happen. The time given to planning was not always rewarded by the achievement of an effective lesson. Quite often extreme behaviours by one or more of the children disrupted his lesson leading to great frustration.

Why the hell bother? I mean, I've had a just, a pretty long chat with my Principal, and I'm apparently going through the "Go stuff it all" phase. But why the hell do we bother? Sitting up late at night, you plan a lesson, and I'll come back to the exact lesson I'm talking about but you sit back and you plan a lesson, and you get some little dickhead jump up and down on your desk, run in, turn on the lights, turn off the lights, giggle, jump in and out of the window, why bother? Dunno (G. Journal 2).

Later in first term, he used skeleton plans from his Daily Work Pad. There was a realisation that much time was expended in detailed planning, which might have little effect in the classroom. A change also came from the critical frustrations he experienced in working with the children. He also experienced tiredness, and had little energy to spend in extensive planning and preparation, which took considerable time. His plans appeared to be related to how the lesson might be conducted with a theoretical class, rather than the actual class. He did not initially plan for the behavioural reactions of the class and adjust his expectations to accommodate this aspect.

... well it spun me out so I'm gonna tell you all about it, I thought it was just so cool. I haven't actually got a formal lesson plan for me to read because I didn't make, make one up, it just came off the daily work pad (G. Journal 3).

...a quick question to throw at you, time-wise, time factor, resources, games. There's so many things you can do from this syllabus, um, for making up games for kids to do. But the time to do them, I've just come home and I'm absolutely knackered and, and tired and just exhausted, I don't have time to sit up till midnight making board games and bits and pieces for the kids. Um, don't know where we go with that but it's an interesting thought (G. Journal 2).

Whereas difficulties in resourcing activities led some cases to revert to textbook exercises, Gaz was able to review the situation and adapt his approach so that he could continue to use games. These games were, however, ones that required few, if any, resources or materials. This was a move for change. Gaz's view of games, 'board games and bits and pieces', was being forced to adapt to his situation. He started to use games that required few, if any, formal resources and adopted a game playing format to his lessons, rather than play board games for recreation and fun.

What I've done, and I think it's a good thing actually, is the whole number strand I'm gonna try and teach uh, through playing games, playing board games, playing bits and pieces. Um, and I'll run it past you and, and we'll take it from there (G. Journal 5).

Gaz appeared not to have the same degree of concern about the need for syllabus coverage, as other members of this project. This concern was present at the start of the teaching year, but he abandoned it in favour of a pragmatic approach, largely dictated by the reactions of the children. The extremes of behaviour shown by the children, and the support of the school, allowed him to adopt a different teaching pedagogy. This was in contrast to that favoured by the other case study teachers in the initial stages of their first year of teaching.

## Other sources

Gaz found the West Australian Mathematics Syllabus to be both a saviour, and a problem. The syllabus was a most useful document for Gaz, as it presented something that could save him time and effort, and was a great source for teaching ideas and tasks. On the other hand, the syllabus presented a level of learning that was beyond the capabilities of most of his class. This latter aspect was only a minor issue, as he realised

that with his children it was most important to achieve understanding, rather than strive for coverage at a shallow level.

The syllabus, being the old mathematics syllabus, um, well obviously looks slightly outdated, however I believe it is excellent, it is just fantastic for first year out teachers who are struggling in the classroom, and I accept that I'm doing it the hard way, struggling in the classroom. The, the simple steps, the, this is the um, objective, and these are some suggested activities to achieve that objective, um really helps for accountability. Um, especially I've got a couple of parents who would love to give up their day jobs and come and teach, and prove me wrong. So it really makes it easy to say well, hang on, this is what I need to teach, and this is how I'm teaching it, and this is something that agrees with me, and I think that is excellent (G. Journal 2).

Gaz also saw the syllabus as not only a source of teaching ideas but also as a form of justification for what he was doing, when challenged by parents or others. He looked at the lesson or activity examples as his starting point for teaching rather than, as Stephanie and Harry had done. They used the scope and sequence list of content headings from the syllabus as a list of things that had to be taught. From his starting point, he worked towards a more open and active style of teaching. Stephanie and Harry applied their beliefs, and limited, pedagogical knowledge to the interpretation of the content, and were therefore more prone to a traditional, textbook approach.

The availability and provision of resources to support his teaching was not a problem for Gaz. Generally, the classroom or school was adequately stocked to provide for his material and resource needs. For example, when he wished to use calculators, as one way to support and develop children's ideas, they were easily available in a class set.

Every Friday, um, I'm gonna introduce calculators for the second term. Um, every Friday, calculators, and I will try and pick up in the lesson to talk to you about next term when we get into that (G. Journal 9).

This aspect of the school provision meant that Gaz could develop his pedagogical practice as he wished, without limitations of lack of resource provision. There was also an implicit notion that, as the calculators were present, the school approved of their use. This was not the case in the schools of the other beginning teachers.

## Patrick

Patrick's initial reaction to the school appeared to be a factor in his mathematical teaching. As with the other cases described here, influences on his pedagogical practice need to be considered in combination, rather than as separate, unrelated factors. For example, for Patrick the school appeared to be a major factor on his practice, but this then impacted upon the children, who appeared to be generally negative about mathematics.

### The present school context

Patrick commented at the first meeting that the emphasis within the school was not on mathematics. Other areas, for example religion and language, received attention in the school. Another member of staff commented that she hated mathematics, always had done and did very little in her classroom. She was the Year Four teacher who had worked with Patrick's children in the previous year. Patrick remarked that a similar feeling related to mathematics existed throughout the school. Even if Patrick wished to change the general teaching style in mathematics and introduce practices other than a traditional, textbook, worksheet completion method, he would need to be quite confident in his own ability and justification. Patrick noted support from the other Year Five teacher who shared with him worksheets for mathematics. This confirmed and continued a traditional pedagogical practice in mathematics teaching.

The Principal inspected the teachers' planning for mathematics, as well as all subjects, and there was a felt expectation that plans would meet the syllabus requirements related to content and that traditional practice was the accepted way to teach.

### Children's reactions and behaviour

The children, Patrick noted, were quite accomplished at addition and subtraction, but showed little enthusiasm for mathematics in general. They were typically negative, he suggested, about doing mathematics, and wished to stay within the procedural, textbook style of working they knew. Patrick wished to alleviate the negativity shown by the children by introducing mathematics teaching that was not textbook or worksheet based. Initial attempts were met with some resistance from the children. They did not work well,

stay on task and achieve the results expected by Patrick. He was, thus, not encouraged to develop that style of teaching much further.

## **Pedagogical knowledge**

Patrick's response to the pre-project questionnaire indicated that he was not scared of teaching mathematics, was confident in the methods for teaching it and was secure in his own knowledge of mathematics. When faced with the actuality of the classroom and a class of negative children, he declared that he did not know how to approach teaching mathematics in more exciting and interesting ways. Patrick had a traditional view of mathematics and mathematics teaching and this had held firm throughout his teacher education course. The teacher education course in mathematics placed an emphasis on different ways to teach mathematics, but it had not transferred this emphasis to Patrick's teaching methods. Patrick felt that he needed to work in non-traditional ways as this was an emphasis on the teacher education course and the 'fellow worker' was the lecturer on that course. He felt that non-traditional mathematics teaching was more likely to be motivational and engaging. This was possibly a way for him to survive the negative reaction of his class to mathematics in general. He did not have experience of working in these non-traditional ways.

## **Summary**

The children in their classroom influenced both Gaz and Patrick in their pedagogical practice. The influence, however, had a different effect. For Gaz, the children and their limited ability meant that a traditional textbook and worksheet way of working was not possible. When he tried a different method and found success, he was encouraged to continue with it. Patrick faced negative reactions against mathematics, in general, and stayed with the method familiar to the children. The school also influenced their way of teaching mathematics. As with the influence of the children, this was a different influence in the two studies. Gaz's school allowed and supported him to find ways that were effective for him and his children, whereas Patrick's school appeared, from the limited evidence, to condone only a traditional approach.

## Research Question 2

*To what extent do the following factors influence the pedagogical beliefs of beginning teachers in mathematics in the primary school:*

- previous school experiences;
- teacher education course and school experience;
- the present school context;
- mathematical content knowledge;
- pedagogical knowledge;
- time constraints;
- children's reaction and behaviour;
- the beginning teacher's education;
- professional development;
- the researcher; and
- other sources.

As noted earlier, data related to these case studies are very limited, and thus only very tentative and initial descriptions are offered in the following discussions. Data related to Patrick's beliefs about mathematics teaching are very limited and cannot offer even tentative descriptions of what was involved. No description of Patrick's beliefs or the influences on them will be offered in this section.

## Gaz

### Children's reaction and behaviour

Not only did the children by their behaviour have an influence on Gaz's pedagogical practice, they also began to impact on his pedagogical beliefs. Gaz had a traditional view of mathematics and mathematics teaching when he started work with his beginning teaching class.

I'm a traditionalist. Maths for me, when I was at school, wasn't necessarily always fun so I'm thinking well if maths for me wasn't fun then surely maths for kids shouldn't be fun. Um, the wrong way to look at it, and I guess that's why I've become against the traditionalist. The kids are playing the games, they love doing them. They are working, I'm not sure they're



working to their capacity yet but that's something for me to work out. But am I teaching them maths, and that's what, that's what I'm struggling on I guess, and that's what this is all about, I guess it's more of a justification for me. Am I teaching them maths or not? Um, and I've never actually been put in a situation like this where I've had to confront, confront what I initially believe is mathematics. I'm not doing it, you know, mathematics is numbers on the board. Six plus seven. Get these counters. Get that counter, on the blackboard. Right. Number two. Or traditionally, maths to me is times tables, once two is two, two two's are four, three two's are six, traditionally. I feel like I'm not doing it yet. C seems to think I am and, that, that's a weird feeling when you do something, and you're carrying on with something, then you sit down and you think well, yeah, this seems right, the kids are getting the outcomes but, no this is all wrong. Dunno. Um, I'm gonna keep doing it and take it from there and I'll definitely, definitely, definitely, want some sorta input on how you get your feelings around, or your emotions I guess if you like, around something that you're not quite sure about (G. Journal 6).

Later in his journal, he described the changes in his beliefs about mathematics and mathematics teaching.

Mathematics I guess I think in my own head is that, it's about numbers. It's about adding, subtracting, dividing, multiplying, money, decimal points, place value, all those words. It's not necessarily about living. And I think that's, that's the key thing I learnt today, is that you can do maths, or kids do maths every day without actually knowing it. How long it takes them to get to school, oh gee, it takes me about ten minutes to walk to school, I have to be here at eight thirty, um, so I need to leave when the big hand's on the four. Yeah. That's maths, they've worked out that, you know, they've done subtraction. They may not actually know it but they've done it. And that's something I wasn't aware of, or wasn't focused on, is that maths is more than chucking up a whole heap of numbers on the board and saying let's boogie, let's get on to these and let's see what rolls. Um, philosophical perhaps, ah, interesting week definitely (G. Journal 8).

The fact that children could not or, in some cases, would not respond in normal ways to his teaching made Gaz re-evaluate both his mathematics beliefs and mathematics teaching method beliefs. The successes that he experienced with the children, and the learning he achieved while using these different teaching methods, were major influences on his beliefs about mathematics teaching. Even with the obvious achievements by the children, Gaz still found it difficult to change his ingrained beliefs about mathematics teaching as shown by his earlier journal reflection where he felt he 'was not quite doing it [mathematics] yet'.

## The present school context

An important factor, which influenced Gaz's belief about teaching mathematics, was, as noted earlier, the lesson taken by the Principal. It appeared that the fact the Principal had undertaken a calculator lesson with Gaz's children and Gaz's lesson plan, was a crucial factor in the experience. Gaz was not just told what to do with the children but witnessed it happening, the latter having a more significant and dramatic effect on his pedagogical belief.

Like I didn't expect them to have a clue what I was talking about. He did the lesson again, the exact same lesson. He stopped it, got them on the mat, called oh, made fun of me in, in a nice way um, and he did the exact lesson off the lesson plan I did. And it was a huge success. I pre-judged them, I didn't think they would cope. They didn't cope, the Principal, pre-judged them, thought they would cope, raised them, brought them to the occasion and they did cope

And it was like, wow. I pre-judged negatively, the kids were not interested because I was, I was teaching them as if they were stupid, and no one likes to be treated shit. I didn't like it, I don't like it. No one likes to be treated stupidly.

Um, allow students to complete answers using the overhead projector. Well obviously he was able to make the exact same lesson using the exact same steps that I wrote, didn't change anything, didn't change the order, just expectations of kids need to be there. You actually need to give them a go. I wasn't willing to give them a go and it backfired. Interesting lesson (G. Journal 10).

The calculator incident described above had a profound effect on the way Gaz responded to children and on his belief about mathematics teaching. He was now beginning to see that children could respond in positive ways if they were given such an opportunity. The opportunity for children to think about a situation rather than respond to a closed question challenged Gaz's beliefs about mathematics teaching and offered a different viewpoint.

## Beliefs about mathematics and mathematics teaching and learning

Gaz held a traditional belief about mathematics, that is, mathematics is about numbers, formulae and procedures. Success with other non-number areas of mathematics content, such as aspects of shape and measures, gave him a much broader appreciation of what constituted mathematics. He was able to see mathematics in wider situations, and was able to see how children learned mathematics in aspects such as shape work, practical

activities and game playing. All of these factors began to influence his beliefs about mathematics and mathematics teaching. He had found, and used successfully, the mathematics syllabus. From these successes he had gained not only a wider view of mathematics as portrayed by the syllabus but also a respect for it and its mathematics content. This stance was in contrast to Harry who thought it was useless.

Mathematics for Gaz was now more than arithmetic and the four rules of computation, which was a step along the road to considering mathematics with a wider definition, more in line with some modern recommendations. He had developed a grasp of what constituted mathematics and from here, he was better able to think about the teaching of mathematics with his class.

## Summary

The main influences on Gaz's pedagogical beliefs appeared to be the children and the school context. The children by their reactions and limited ability forced him to reconsider his teaching methods. The positive reaction and learning outcomes from this change of practice, and the negative outcomes from his believed method, began to influence his held belief about mathematics teaching. It was his reaction to the children that appeared important. Unlike Harry, who did not recognise success in non-traditional methods, he saw success and built on it in future experiences for the children.

## Research Question 3

*To what extent is an empowerment model of professional development, with fellow worker support, an effective way to help beginning teachers develop as professional teachers?*

Patrick completed only the first meeting and a cursory second meeting. No description of his interaction with the empowerment model will be given in this section. Gaz completed only half a year with the project so the description of the empowerment model with him is brief. Gaz provided interview data and a detailed personal journal for the first two terms of his beginning year. Description and comment will be given from these data

sources. From the descriptions of Stephanie, Tiffany and Harry it appeared that the model started to take effect in the second half of the beginning year. There is no evidence related to this time for Gaz as he had left the project, thus any comments reported here are necessarily limited.

### The professional development support model

Gaz was enthusiastic about the project and welcomed the possible support that it would offer. The first couple of meetings consisted very much of the ‘fellow worker’ offering various options that might be useful to help resolve the difficulties identified by Gaz. It was quite noticeable from the transcripts how much space consisted of the ‘fellow worker’ outlining possible activities or methods of action.

L: So, if I wrote that, they could then?

G: To a certain degree yep. You’d make ...mark. Um, yes.

L: Right. So, that’s an option. Seems to be an option that you do the oral stuff and then they give you verbally a sentence or what they want to say about it. Someone else writes it and the kids have to copy underneath. Now, that I think has a useful option in that it is their words.

G: Yes.

L: What about and I don’t know what you’ve got in your classroom and I don’t know what the kids can do, what about if they were to use say a word processor? Have you got a word processing package in your classroom?

L: ...have a look ...Another thought is if. What’s these kids like on recognising letters? Can they recognise A?

G: I think they could. I think that they...a lot. Um.

L: Well okay, let's just talk for a minute and see what might come out. So, they might, with the help of someone else, maybe another kid, ...and then just print that and stick it underneath. Seems a bit complex to me that one. And, another way might be to say ...write me a sentence? ...just, I'm not going to give you any words or anything, just write it and then ...come back later and they tell you what ...and then you then write it underneath. So, that switching it ...Just try something, write me two words and I'll come back in two minutes. ...um, do the oral stuff at a point where you get them to record something and ...that they have a buddy ...whose job is at that point to work with them.

G: Yep.

L: There's an option. What other options can we have? Come on. You must be ...work these actions out. You know your kids. Um, another option. You were talking about your cutting and stick it.

L: Well maybe that's another teaching bit. ...what they say. And then if to say you having to keep doing it, there's a technique called ...forgotten. Forgotten ...Which is based ...and where ...on paper—on card you have all these words. Um, lots of words and you would need to build up their word banks of words which are relevant to them. And there would be a piece of, we could do it in a number of ways. It's easier on card, they don't have to make up a sentence which they make up by taking the and putting it under ...and five and so ...by putting words that and then they can read it and then get a copy. And if you've got these on card you and keep using them, whereas if they are on a photocopied sheet which they stick you don't get them to reuse. So, you may set them a task of how to use these words to put together to make a sentence. So, what we are trying to do is to try avoid the writing bit at the moment. Another option um, I'll tell you

what ...is in a minute, but that's what it is. And 'Break through'. That's what it's called. ...And they would have um, the traditional ones have them in a folder like that with these little slots. And they'll have all their words down one side to select from and this side ...more ...where they would make their sentences.

G: I do like the idea. I like that a lot. (G3).

Some of the options were new and had not occurred to Gaz, even though the 'fellow worker' felt that they were obvious and that everyone knew about them.

L: And, what sort of thing do other people do?

G: I'll be honest and say I haven't asked. ...which is always a bad sign.

L: Now I don't know who works with Year Twos, Year Ones, what techniques do they use and that will add to your list of choices.

G: Yes, no, um, do you realise that that's bad. ...That is bad, a bad thing. Um, although.

L: What's that?

G: That I haven't answered ...(G4).

With Gaz, it was difficult to ascertain which, if any, of the options had been employed in the classroom. The options acted much more as an accumulation of alternatives to his traditional view of teaching. In that sense, they began to legitimise his deviation from the traditional model. This use of the 'fellow worker' aspect of the model was useful for Gaz. He was very willing to discuss his developing thoughts on a number of issues, which arose for him, and often requested conversations with the 'fellow worker'.

C [a colleague] seems to think I am [doing alright] and, that, that's a weird feeling when you do something, and you're carrying on with something, then you sit down and you think well, yeah, this seems right, the kids are getting the outcomes but, no this is all wrong. Dunno. Um, I'm gonna keep

doing it and take it from there and I'll definitely definitely definitely want some sorta input on how you get your feelings around, or your emotions I guess if you like, around something that you're not quite sure about (G. Journal 6).

The options aspect of the model was useful with Gaz as it offered ways to overcome his immediate problems with teaching his class. It was also a positive way to support Gaz's struggle for survival. Gaz had an advantage over the other teachers in the study. He could access the school support system of the Principal and the occasional in-class teacher when the need arose. The visits of the 'fellow worker' provided a vehicle for reflection and a catalyst for Gaz to verbalise some of his thoughts and feelings.

### The action research model

Data are too limited to make much comment on this aspect of the model based on actual evidence. Evidence from the first half of the year showed a similar pattern to other participants in the project. Namely, an issue was identified, but the action in the classroom by the beginning teaching was minimal, thus giving little for the next phases of the cycle.

I really need, and I think because my behaviour problems and the fact that I've got so many kids in this class who haven't succeeded in anything, I really need help with mixed abilities, and I guess that just keys up, or gives a quick brief insight into a quick look at why I need help with my mixed abilities (G. Journal 1).

The issue—the mixed ability nature of the class—was, however, a recurring theme throughout the interviews and one that was also a problem for all participants in the project.

### Teacher reflection

Gaz was able, unlike other project members, to complete a weekly personal journal. The taped journal lasted for most of the first two terms but dropped away during Term Three, as other personal issues crowded into Gaz's mind and his time. He grasped the idea of the journal and found time, often on the way home in his car, to complete it. He had similar

issues to the other teachers to confront but managed to find the time more often than Harry to add to his journal.

Reflection, both within the journal and the interview meetings, allowed Gaz to see what was working and to identify his successes amid everything else that was happening. The following is typical of his reflection.

I can honestly say it was my best lesson so far, um, the thing that I really, really, really liked about it is that I had this poor, the poor person standing up didn't measure and that was a problem, that was always gonna be a problem. But I had kids um, I'm trying to think of one, I had three kids measuring different body parts at the same time on this one kid, and if that doesn't give you, okay so they can measure in maths, but if that doesn't give you an insight into right, these kids can actually co-ordinate themselves and work as a group, I don't know what does. Their social interaction was amazing. It is a very, very cool lesson. Um, excuse me, my voice is starting to go. The skeletons were actually hung from the roof and, I mean everybody who's anybody commented on how good these skeletons were (G. Journal 4).

Reflection proved to be a useful technique for him to change and develop his pedagogical practice and to survive. The act of reflecting was most powerfully seen when Gaz observed his Principal work with Gaz's own lesson plan and children. The quality of reflective thought and analysis shown by Gaz was often high.

... Orally, E can get out his eight counters, add four to them, he knows that it's twelve. Wouldn't have a clue how to add or write eight and four should I say, wouldn't have a clue how to write the answer, but knows how to count. E, anything over about 16 and he doesn't know what comes next, ah he'll go, you know, 14, 15, 16, 20, ah 43, so he just starts guessing random numbers, numbers that are in his head.

... success that they've had, the taste of it, the, the feeling of hey, I may be able to get away and do some of this, this isn't all that boogie hard freakish kinda stuff that perhaps I thought it would be, is, has worked really well for them, and they are coming along in leaps and bounds.

... I think it's not experience, I think it's more of confidence thing, um, in order to cater for everyone's individual needs rather than pitching in a lesson, and, letting the able kids move on from that, and trying to keep the less able kids with me. I think that's, that really really, really, really, needs improvement, um, for, well, second and definitely third term. Um, so yeah, I guess in all that, when you look back, a good first term, learnt a lot, um, mathematically enjoying um, all three strands. Space is looking excellent, I've got that set up well. Measurement with the skeletons and just got really, really liked, like measurement, we're doing well cutting up the straws, and number which we're doing basically through games is also good (G. Journal 9).



The interview technique employed by the ‘fellow worker’ of asking the beginning teacher to describe successes and positive incidents proved to be useful in obtaining critical reflection. The use of a technique similar to the ‘critical incidents’ of Tripp (1993) combined with the request to reflect turned, what for the busy teacher might be a normal activity into a learning experience. In the reflection from his journal reported above Gaz analysed in detail what specific children can do and what he had to do to account for the differences.

## **Change in classroom practice**

Change in how Gaz taught mathematics was obvious after only a few weeks of Term One. Change was forced upon him by the nature and ability of the class, but was supported and encouraged by the empowerment model. Within two terms, Gaz had changed from a traditionally orientated teacher of mathematics, to one who was more aware of the needs and abilities of the children. He changed from a style of teaching that required children to colour six ducks on a worksheet, to one that had them involved in game playing to learn mathematics. He worked in all three strands of the syllabus, rather than purely in the number strand. Both his teaching style and his view of what constitutes mathematics had changed. For him teaching was more than imparting knowledge, and mathematics was more than procedures for completing calculations.

## **Summary**

The empowerment model employed with Gaz seemed appropriate to support his struggle to come to terms with the realities of his classroom and the behaviour of his children. It dealt with his problems and issues, in his context, rather than some generalised issue for beginning teachers. The use of options allowed Gaz to pick-and-choose, or ignore as he wished. As with the other participants in the project, Gaz found the action research aspect beyond his capabilities, as he was more concerned with survival than experimentation and observation. The use of reflection, via the teacher journal and the ‘fellow worker’ meetings, was effective in supporting Gaz to develop his pedagogical practice to suit the needs and constraints of his classroom.

## Chapter 9

### **Recurring themes, emerging issues and dilemmas**

#### **Introduction**

Chapters 5, 6, 7 and 8 of this thesis discussed the data in relation to each of the Research Questions at the level of each beginning teacher. The chapters considered how they reacted to the experiences of the first year of teaching, what influenced their teaching practice and beliefs, their interactions with the professional development model, and identified how they had changed during that time. This chapter will identify similarities between cases and discuss common issues at a general level, rather than at an individual level. It will identify and discuss aspects of the data in the form of themes that recurred, issues that emerged, and dilemmas that were faced by beginning teachers. Unlike earlier chapters, the discussion here will be of a general nature, rather than grouped under sub-headings related to each Research Question.

This chapter will compare and contrast the themes, issues and dilemmas identified in the case studies of beginning teachers. The themes, issues and dilemmas appeared as significant classifications arising from the analysis of data in the case studies. Data were sorted into these categories for further analysis and comment. For the purpose of this discussion, the following definitions are used. Recurring themes are those things found in most or all of the case studies. They continued throughout the first year of teaching. Emerging issues appeared during the life of the project and, in some cases related to one particular teacher, but more often occurred to other project members. Dilemmas were situations which caused the beginning teachers to make a decision between two apparently equally important choices.

The idea of recurring themes, emerging issues and dilemmas is not new. Malone (1995) identified six emerging themes from the subjects' teacher education course, and four evolving themes from their time in the classroom, in his study of preservice, secondary,

mathematics teachers. The emerging themes were classroom relationships, management, discovery activities, assessment, communication and motivation. Four evolving themes were shared, namely student learning, active student involvement, management, and motivation. Berlak and Berlak (1981) identified sixteen dilemmas for teachers, while Katz and Raths (1992) reduced dilemmas to six by grouping them into families. They suggested the dilemmas were endemic to teacher education and unsolvable. Lampert (1985) noted that dilemmas were never solved, but that teachers had to develop methods to manage their dilemmas. These dilemmas were related to teachers in general, not specifically to beginning teachers and to mathematics teaching in the primary school. The discussion in this chapter will highlight dilemmas faced by this group of beginning teachers. It will also consider if the dilemmas changed as a result of the beginning teachers passing through the stages of their early career. Earlier research on beginning teachers identified stages through which novice teachers passed (Burden, 1982; Katz, 1972).

## **Recurring themes**

The first set of recurring themes discussed fall mainly under the first research question. The themes were control, time constraints, coverage of content, mixed ability teaching and assessing what children knew. They relate to the influences on the pedagogical practices of the beginning teachers in this study. As has been noted before, however, the themes, issues and dilemmas highlighted result from a complex, interrelated situation and aspects of each research question may be seen in the discussion. The first recurring theme from all the beginning teachers was control of the behaviour of the children.

### **Control**

Even though all the beginning teachers in the study had been in classrooms, had taken responsibility for the day-to-day running of a class on their final teaching practice, and, in the case of Gaz, knew the children, the move to their own class provided a 'reality shock'. They found control difficult, they worried about it and it dominated their early actions and responses. A consequence of this was they adopted a pedagogical practice that was

tightly controlled by the teacher and traditional in style. Lessons were controlled by the teacher ‘from the board’, were mainly about procedures and were often based around textbooks, worksheets or blackline masters. All children, regardless of ability received the same mathematics, at the same time, in the same way. The beginning teachers justified this style of teaching, often implicitly, as necessary to help them control and manage the children’s behaviour. They reasoned that traditional pedagogy was conducive to control. If the children were at their desk, working from a textbook or worksheet or sitting listening to the teacher, they had no reason to talk, walk about the classroom or interact with their peers. The classroom would be quiet, busy and orderly, all features of a classroom of a ‘good teacher’. There was a perception among the group, especially Harry, that they had to prove, and prove quickly, to the Principal, their colleagues and the parents, that they were good teachers. The need for control determined the pedagogy, and in the eyes of these beginning teachers, that pedagogy was traditional in style.

During the first two terms other aspects of pedagogical practice were tried very warily, for example, Gaz introduced game playing. Harry and Tiffany tried using materials. These approaches put a strain on the control aspects of the class, and, in the case of Harry and Tiffany, were abandoned in favour of a more traditional style of teaching. Gaz, on the other hand, while conscious of the increase in noise, continued, as he saw pupil motivation and better learning as results of the game playing style. He was also aware that returning to his teacher-led style might reduce the noise level slightly but would not add to either his class control or the quality of the children’s learning.

Control, as a theme, recurred in conversations throughout the beginning year for all teachers. It was, however, most notable as the major feature in the first two terms—the survival stage for these beginning teachers. It led to a traditional, teacher-controlled pedagogy for all beginning teachers in the study, apart from Gaz. For Harry, and possibly Patrick—though data was restricted in his case—the need for control led to a traditional teaching style, and confirmed a belief that good mathematics teaching was of this form. Other members were less set in their beliefs about mathematics teaching and were more prepared to attempt other pedagogical practices with their classes. It appeared for Stephanie and Tiffany that as soon as they established control they could change the

pedagogy. Thus, it was important for the beginning teachers to feel confident in their control of the class before any suggestion of different, possibly less traditional, forms of pedagogy was contemplated. For two of the cases described here, the confidence came after the survival stage of their beginning year of teaching.

The underlying belief system of teachers such as Stephanie and Tiffany was important in their adoption of experimentation and change. They appeared to have a less strongly held traditional belief about mathematics teaching and wished to use a non-traditional model of teaching. They were willing to try aspects of pedagogy once they passed the survival stage and control was secure. That is, those teachers who believed in other pedagogies moved more quickly to change and experimentation once control was established. Those teachers who fundamentally have a traditional belief are slower to think of changing.

A major feature of the professional development model established in this study was one that attempted to question the cycle of a traditional pedagogical style as a taken-for-granted method. In the case of Harry, the model had to help him move to work in other ways. With the other teachers, it was designed to support their initiatives to vary their pedagogical practice, once the overriding control factors were less of a concern for them. The model of support was flexible enough to accommodate both sets of needs.

## Time constraints

In her list of “areas of uncertainty” for teachers, Gill (1998) noted “time management” as one of these areas. She identified four sub-areas, namely:

- Perception that there is “never enough time”;
- Concern over the impact of “non teaching, managerial issues”;
- Difficulty in achieving long-term planning; and
- Anxieties about “keeping up” (p. 101).

All the subjects of this study mentioned time as a factor affecting their teaching style. For Stephanie, time, or lack of enough time, was a major concern. She was very conscious that she had to 'cover the syllabus' and that there was insufficient time during the year in

which to do this. Her teaching practice, and that of Tiffany and Harry, adapted to a traditional style, as this was perceived to be a more time efficient way to cover the syllabus. As the teachers controlled the amount of time available for a specific piece of work, they could move to the next stage or page of the textbook, as and when they felt necessary. More open-ended or discussion-based work was seen to take longer to complete and less work would be covered. Textbook pages and worksheets could easily be finished at home if they were not completed in class time, thus allowing everyone to keep up. More will be discussed about coverage in a later section.

Gill's (1998) sub category of *never enough time* also impacted on teaching style. Gaz, for example, noted that there was not enough time to plan detailed, interesting activities or construct game boards. He arrived home, dealt with the day-to-day things of school and was generally too tired to spend a lot of time preparing lessons and activities for his class. Harry generally did not do lessons that involved materials or collecting data, as he did not have enough time to organise their identification and collection. A hand-to-mouth preparation style due to lack of time confirmed him, and, at times, others, into a traditional mode of teaching using the textbook and then only those pages which required little or no pre-lesson preparation. The issue of planning will be considered in more detail later in this section.

## Coverage of the syllabus

An anxiety for the beginning teachers in this study was, as has been mentioned earlier, to be seen by others to be a 'good teacher'. Part of their vision of a good teacher involved making sure that the teacher for the following year could say that the children had been taught everything in the syllabus for that previous year. Gill (1998) noted this as *Excessive attention to "covering the work"* in her list of areas of uncertainty. This anxiety led to Stephanie spending considerable time discussing coverage during project meetings and gearing her planning to make sure that everything was 'ticked' on the Western Australian Mathematics Syllabus scope and sequence chart. Harry, in his anxiety for coverage, had covered everything in number and measurement on the syllabus by the end of Term Two. He then proposed to revise the same work in Term Three and add in bits of the space strand, which he had dismissed as not being important. The need

for speed of coverage, to be able to complete all of the work before the end of the year, meant that teachers adopted a 'one-off' approach. Each piece of the syllabus tended to receive one lesson, before the next lesson moved to the next piece of learning from the syllabus outline. Harry, in particular, dismissed the notion of working with the children in ways other than using a textbook or teacher-taught procedures. Other ways of working, he argued, took longer to complete and delayed the children covering the syllabus content for their year group. Harry attempted to cover the traditional content of number and measurement as he thought these aspects were important. This also reflected his beliefs about mathematics and mathematics teaching. He did not value equally other parts of the syllabus, for example shape and chance. The emphasis, in the need for syllabus coverage, was on a 'taught coverage', rather than a 'learned coverage'. This emphasis was particularly notable during the survival stage of the teachers.

Gaz was the only member of the project to be aware of the need to spend more time with each piece of learning with his class. He noted that, for example, a game playing pedagogy took longer to complete. However, he justified the extra time taken in terms of the better quality of learning achieved by most of his class. This realisation came early in his beginning year and he was quite prepared, consequently, not to be able to cover all of the syllabus entries for his class. For Stephanie and Tiffany, it was not until almost Term Four that they became more relaxed about the need for syllabus coverage and began to adopt variations in their pedagogical practice. As they became aware of the quality and depth of the learning needed by the children, they began to be less anxious about coverage. They began to see the children as learners rather than something to be controlled and, consequently, began to consider and use teaching strategies and practices that were not traditional in style. The perception that there was less importance attached to syllabus coverage led to a less traditional pedagogy. Stephanie and Tiffany, in particular, began to consider the learnt syllabus, rather than the taught syllabus with its implicit assumption that if something is taught it will automatically be learned by the children.

## Teaching mixed ability children

Once the beginning teachers moved beyond the first term or two of 'survival' the problem of working with children of different ability levels became apparent. All participating teachers, apart from Patrick, had not only mixed ability levels within a year group but also had multi-aged groupings within the class. Harry, for example, had to manage children from three year groups—Years 5, 6, 7. The teachers with multi-year groups had some help. For example, in Stephanie's class, someone would take the Year Six children out for short periods during the week, or a teacher's aide was available at certain times. This support, however, did not release the teacher from the responsibility of planning and organising appropriate work for the children. Thus, the teachers found that in the first few weeks of their first year of teaching they not only had to plan for a mixed ability year group, they had also to accommodate, within those plans, work for more than one age group. In addition, they had to make sure that support teachers had appropriate work for their groups of children. This is a situation to tax experienced teachers. For the beginning teacher one way to cope was to use a traditional method of matching children to textbook for their year. In the case of the teachers in the study, these books were the main ones adopted by teachers in Western Australia—*West Australian Mathematics* (WAM) or *Mathematics Today Series* (MTS). Both books were explicitly aligned to the stages of the Western Australian Syllabus. The beginning teachers saw the stages as equivalent to year levels. In this way, the beginning teacher could show that they were doing appropriate work for the year group and, at the same time, were covering the syllabus content. Adopting a more traditional pedagogy, especially techniques such as textbook use and 'teaching to the middle', allowed the beginning teachers to avoid explicit planning for mixed ability. This aspect did not change greatly during the beginning year. The only deviation was to spend more time with those children who did not grasp the idea as quickly as other children within the class. Those children who were quicker or more able, generally did not receive work more closely matched to their mathematical ability and need. They were often given more work to do, or assigned trivial tasks and 'busy work'.



## What do children know?

In all the case studies, the teachers showed concerns about their lack of skill in identifying what the children knew. Two aspects of this question arose. Firstly, an assessment question related to testing children's knowledge of the material recently taught. Secondly, a planning issue concerned with the level of knowledge the children brought to the new teaching situation. This information was needed so that the teacher might establish where to start the next bit of teaching. The discussion will consider both these aspects.

### Post-teaching assessment

A consequence of textbook use and school practices was to drive the beginning teacher to a traditional pencil and paper style of testing. A traditional teaching style led to a traditional assessment style. For Harry, it confirmed his belief in the way to teach mathematics. He implied that if you were emphasising and teaching facts and procedures for calculation, then a traditional pencil and paper test of those facts and procedures was most appropriate. The 'end of teaching' testing was also quicker, took less detailed planning and, for a beginning teacher with limited experience and already under time pressure, it presented an attractive way to work. The textbooks that were being used had embedded tests in their pages. This added to the frequency of the use of pencil and paper tests. Early in the year, there were discussions with Stephanie and Tiffany on using task-based assessment, portfolios and journal writing, as alternative means to assess children's mathematical ability. At that time, the suggestions were beyond their pedagogical capabilities and were not established. They felt that they were unable to control the class well enough to move away from a test situation. They were familiar with this style of working and liked it as it had a strong control element in its structure. Later in the year, however, Stephanie began to experiment with portfolios and simple journals, while Tiffany worked much more with observation schedules. Their assessment pedagogy had changed along with a change in their teaching style.

### **Pre-teaching assessment**

The other planning-related point, that is pre-teaching assessment, appeared early in the year for Stephanie and Tiffany. Both beginning teachers identified two related problems as part of their first action research cycle. Firstly, they had the problem of not knowing what children of a specific year could do and secondly, they lacked information about what their specific children knew. The teachers began to know their children more deeply once they started to reflect on the problem, and had taught a few lessons. At this time, the problem became more apparent. It was closely tied into the problem of teaching mixed ability and matching appropriate work to children.

A suggestion of using a pre-teaching task as an assessment item to establish or 'tune in' to what the children knew about the content was offered. A second option offered was to ask the children to respond in writing to a series of question prompts. These prompts were to establish what they thought they understood, where they had difficulties and what they wanted to know. While both strategies were accepted with enthusiasm by the beginning teachers, neither were immediately put into classroom practice. Critical reflection influenced pedagogy and assessment slowly and for Stephanie and Tiffany, these ideas were used later in the year.

It appeared that suggestions were not used immediately in classroom practice because of a combination of factors. The ideas moved too far away from the beliefs of the beginning teachers. Also the options were too complex and the beginning teachers could not cope with the implications of working in the suggested way. Consequently, they ignored the options. A consequence of assessing in this way was to highlight the range of ability within the class. This would lead to working with more than one group of children in the classroom and possibly differentiated planning and teaching. The combination of these factors put the idea beyond the capabilities of the beginning teachers who were still in their survival and class control phase. Generally, this aspect of their practice, while still a concern, was not developed during the year. It appeared to be too difficult for the beginning teacher to use.

## Emerging issues

As the year progressed and the beginning teachers became more confident and competent, a number of issues, namely planning, isolation and their personal life, began to emerge. Some related specifically to an individual or to the context in which they worked. Others were raised by more than one of the teachers. The following section will discuss issues that emerged during the year for this group of beginning teachers.

### How to plan for mathematics

An assumption was made by the researcher that planning would not be an issue for the beginning teachers. Each member of the project group had been trained in planning. They had attended seminars on general principles of planning, had undertaken a teacher education session on mathematics planning, and had planned for their teaching practice sessions. The assumption was false.

Planning was an issue and, in particular, how to plan for multi-age and mixed ability classes. All the beginning teachers had trouble with planning. They felt they lacked basic knowledge and skills for planning and they felt they did not have time to plan appropriately. It was also a surprise to note that neither Tiffany nor Harry had been required to plan and teach mathematics on their final teaching practice because of the nature of their practices. The teachers required that the planning process should require relatively little time and be simple and straightforward. Stephanie and Tiffany devised their own method, which they refined over the four terms of their first year. Harry used the content list from the textbook series he found in the school. He was also looking for a ready-made version; similar to the 'Chalkbusters' booklets he had been using. He could then photocopy it for his programme to show to the Principal, and follow their simple, ready-made, steps for teaching. It appeared that they had forgotten the experiences of the teacher education programme. In three cases, Tiffany, Harry and Gaz, they had not been required to plan for mathematics. The connection between the teacher education planning input and their actual need to apply the principles taught was not made. The time interval between theory and practice was possibly too large. The theory and principles of

planning may also have been lost because they had not been linked contextually for the beginning teachers.

The lack of knowledge and experience about planning drove the beginning teachers to search for ready-made, short cut answers. These answers reinforced a pedagogical model that was traditional in outlook, textbook-based in practice and content-based in orientation. This inability and inexperience in planning, and especially planning for more complex mixed ability classes was another factor which led to the adoption of a traditional pedagogy.

No models for planning or examples of planning from experienced teachers were seen on teaching practice. In fact, Harry noted that one of his supervising practice teachers did not plan at all, but just worked through the textbook for the year he was teaching. No models for planning were offered by the schools as support to their new colleagues. None of the beginning teachers approached other teachers to see how they planned. No one was teamed with a colleague teaching a parallel class or similar age group to act as a planning mentor. Only Harry, who had to show his plans to his Principal, received feedback that his first attempt at planning for mathematics for his three-age range class was too complicated and that he had to simplify it. No indication, however, was given as to how he might simplify it. Generally, all beginning teachers in the project were left 'to get on with it'. Comments on the appropriateness or quality of their plans were not given. In most cases, plans for teaching were not seen by any one other than the beginning teacher. This contributed to a feeling of isolation, which forms the next issue for discussion.

## Isolation

While all beginning teachers in the project group were placed into schools with experienced staff members, it was as if they were alone in a crowd. All of them taught in classrooms that were separated from other rooms. It was noted in the interviews that when they first started in the school, teachers would 'pop in,' to ask if they were OK. This did not continue as the year progressed. The novice teachers were generally unwilling to accept the offer of help. There was a feeling among the beginning teachers that they did not want to bother their colleagues with beginning teacher's problems, as

these teachers were also very busy. Each beginning teacher was also concerned not to be seen as inadequate, and unable to do the job. They felt that this reaction might be reached if they were constantly asking questions about how one did certain things. They held, to a certain extent, a belief that they should know everything and that any learning had to be done in private.

At the school level, there was little evidence of an explicitly planned and operated support system for new and beginning teachers to the school. None of the schools had a specific policy for inducting or supporting beginning teachers. All beginning teachers noted that they were to be appraised by their Principal towards the end of the first year. Gaz had a fortnightly meeting with his Principal, Stephanie was given a small budget as a new teacher but apart from these instances, they were left alone. Gaz, who worked quite closely with one of his colleagues, when she worked with him and his class during the week, received some thoughts to help him with his management of the class. The discussion earlier in Chapter 8 noted that he had not thought of seeking advice from other members of staff, who had similar aged children or specific expertise, a situation that appeared surprising.

The new teacher to the school received no reduction of teaching load—Harry only taught four days a week but the reasoning here was financial rather than related to support. He was contracted to work for four days. None of the beginning teachers were given, or offered, an experienced member of staff to act as a mentor or helper.

At the system level of the Education Department, apart from the coincidental development work in Stephanie's school, there was no contact or support given. The beginning teachers were allocated a school and from that point there was no contact from the Department of Education. Apart from the contact twice a term with the project and the 'fellow worker' beginning teachers were left alone; isolated in their own room with their children.

The 'fellow worker' went some way to break down this isolation, was an agent for critical reflection, and established a feeling of success, in many of the areas of concern. This played an important part in the development of the beginning teacher.

## Personal life

All beginning teachers in the project had to adjust to the teaching situation and balance this with the impact on their personal lives. Stephanie and Tiffany appeared less concerned than Gaz and Harry. Stephanie was able to remain in her home but had to travel quite a long way each day to reach school. Tiffany, who was located much further away, found temporary accommodation. She lived there during the week and returned to her home in Perth at the weekend. In this way, both were able to reduce the impact of social dislocation from their peers and family.

The two main males of the study—Gaz and Harry—had not only to deal with the problems they faced in the classroom but also their out-of-school life. Unlike Stephanie and Tiffany, they did not have to move home or travel long distances each day to arrive at school. Harry was married with a young son. During the first two terms, he had to manage visits to the hospital, minor complications in his wife's pregnancy and the birth of a baby in Term Three. Gaz was married in middle of Term Three and much of his time was taken in helping with the wedding arrangements. It was at this time that his car was stolen and a little later, after the wedding, that his house was burgled and vandalised. He attempted to juggle all these out-of-school issues, his concerns about his class, their learning and behaviour, and prepare for his appraisal by the Principal. It was at this time that he missed meetings with the researcher and finally, in September, wrote a note withdrawing from the project, due to pressure of work.

These extra and considerable concerns from beginning teachers' home lives, coupled with the anxiety about coverage and time pressure within the classroom, do not make it easy to attempt other pedagogical practices with their inherent risks. A traditional pedagogy was an option that more easily allowed all these issues to be accommodated by the beginning teacher.

## Dilemmas faced by the beginning teachers

During their first year of teaching, the beginning teachers in the project faced a number of dilemmas. The idea of dilemmas, as noted earlier, in teaching is not new (Berlak & Berlak, 1981) but, in more recent times, there has been a shift in emphasis in their

interpretation (Katz & Raths, 1992; Lampert, 1985). Teaching dilemmas, Berlak and Berlak argued do not have solutions; they are unsolvable. They pronounced that teaching dilemmas could only be addressed through compromise. Lampert (1985) suggested that in fact teachers have to become 'dilemma managers'. The next section will consider some of the dilemmas faced and managed by the project group of beginning teachers.

### **Belief about mathematics teaching versus how the university said I should teach.**

Two of the beginning teachers, Stephanie and Tiffany, confronted a dilemma about teaching from almost the first day of Term One. They had recently finished their teacher education course and had been exposed to ideas and issues about teaching. They also had personal beliefs about teaching and learning in mathematics. These ideas, while possibly not in opposition to each other, were sufficiently different to cause some conflict in the mind. The struggle to resolve the dilemma continued throughout the first year of teaching but was particularly acute during Terms One and Two. The dilemma in this case contained a series of parts, each with its own question. The actual pedagogical practice, which occurred, was a result of the beginning teacher managing these questions and dilemmas:

- How I believe I should teach mathematics;
- How others think I should teach mathematics; and
- How I am allowed to teach mathematics.

Stephanie and Tiffany were very conscious of the second question as they wished to incorporate talk, materials and group work into their mathematics teaching. They appeared to have retained some of the main points relating to effective mathematics teaching from their teacher education course. They were constrained initially, however, in what they were allowed to do by the children. Harry, in contrast, managed the dilemma by concentrating much more on the first question (his belief about teaching mathematics) with some influence from the last question related to the children. With Gaz, the emphasis was very much on the last question (how the children allowed him to teach). He had to manage his belief about traditional mathematics teaching and learning with the

realisation that these children did not appear to be learning very well in that style. The emphasis placed by the beginning teachers on each of these questions changed during their first year of teaching, especially for Stephanie and Tiffany. It moved from mainly a performance perspective, to one of developing understanding. The emphasis initially was on the teacher teaching facts and skills and the children remembering them. This was due largely to the influence of the fourth question. Later, they were able to emphasise a combination of the first two questions and attempt to develop understanding by the children. The role of the 'fellow worker' was critical in these issues as it worked as a catalyst for critical reflection rather than reflex reaction. The presence of the 'fellow worker' also acted in a support role. It gave a feeling of validation for any approach adopted, especially so if the approach was different from that perceived to be dominant in the school context. The presence of the 'fellow worker' allowed them to manage question three and the influence of context and tradition.

### Understanding versus performance

All beginning teachers experienced a tension between teaching for understanding and teaching to demonstrate correct responses. It was a permanent feature of their discussions over the year. They had constantly to manage the problem. Time and pedagogical knowledge were major factors, which swayed their decision-making. To achieve coverage of the syllabus content or the textbook pages, which, as discussed earlier, were constraining factors on practice, decisions had to be made regarding which end of the teaching scale one should go. For example go to the 'performance end' and generally the material could be covered quickly. Move to the 'understanding end' and the tasks and learning, while arguably better, would take so much longer to complete. The felt pressures for complete syllabus coverage of content, in many cases, did not make understanding by the children a preferred option. The option of understanding also had to be juggled with the adequacy or not of the teachers' pedagogical and mathematical knowledge. For example, if, as in Harry's case, he did not know how to ask questions or develop deeper content knowledge about an area of mathematics content, then this would be treated at a superficial level even if the teacher felt children should go for a deeper understanding. Where there was a lack of personal content knowledge, as in the case of



open-ended ideas and work in tessellation with Harry, then this aspect of learning was not taken forward into classroom practice. The issue of content knowledge was generally not a concern, as all participants had a reasonable knowledge of mathematics as noted earlier.

### **Less able versus the rest**

This was a constant dilemma for all the members of the project group. Working with a mixed-ability and mixed-age group presented the inexperienced, beginning teacher with considerable problems. One of the recurring issues during interviews and as part of reflective journal was “do I concentrate on the less able and ignore the rest?” Such situations generally occurred when lessons were aimed at the middle range of ability in the class. Problems then arose for the teacher concerning the less able children—those, in Gaz’s case, who could not read or write. Generally, the initial resolution was to start everyone on the same task and then work in a concentrated fashion with those children who were experiencing difficulties in completing the task. The remainder of the class had to cope or, if they were at the more able end of the ability continuum, had to find something else to do, when they finished before the end of the lesson. As time progressed and experience and confidence were gained, other resolutions were managed by the beginning teachers. As noted earlier, this was not a strong area of development in pedagogical practice and generally it remained at a low level with some designated work being set for more able and less able children as well as those from different age groups. The dilemma of where, if anywhere, to place priorities, with a class containing a range of abilities, remained.

### **Risk taking versus playing safe**

After the first two terms had elapsed and they had survived, the beginning teachers were more confident in their ability to manage the children. At this point, they were more willing to try something different in their pedagogical style. In order to try something new, they had to move out of their newly found ‘comfort zone’ and take a risk, a risk that something might go wrong. Should they try something else, with the chances of success

or failure, or should they play safe and continue with the status quo? The fear of a disaster from risk taking was strong, especially as they knew they were appraised by the Principal and were on show to the rest of the staff and parents. However, if they did not take the risk then they might not be able to reach the pedagogical goal to which some of them aspired. The data show that gradually with the support of the ‘fellow worker’, the beginning teachers started to move out of their ‘comfort zone’ and take small risks by attempting different forms of pedagogical practice. Harry was more reluctant to change to a less traditional style of teaching, as he had quite strong beliefs about how mathematics should be taught, and these generally constrained him making any changes. He had taken a risk earlier in the year by using materials and this had not worked well and had presented him with control problems. He was more satisfied with what was happening than Stephanie and Tiffany and was reluctant to change because of this. Stephanie and Tiffany, however, were less satisfied with the level of understanding of their children and began to take risks by adopting a more child-orientated style of teaching. Tiffany even returned to the activity-based style of working, which she had earlier abandoned, as well as beginning to incorporate small aspects of game playing with selected children.

## Summary

Across the case studies common themes, issues and dilemmas can be identified. Some themes recurred throughout the year, while others were typically raised at particular points of the year. The dilemmas were shared, but experienced to different degrees by individuals. The general themes, issues and dilemmas identified relate closely to the influences on the pedagogical practice of beginning teachers. The influence of context in the form of the children and the assumed, in many cases, expectations of the school were the major factors. Control during the stage of survival was the concern for all the teachers. Once this had been resolved then there was more of a possibility that other forms of teaching style would be adopted. The themes that recurred for all beginning teachers in the study were:

- control and behaviour management of the children;
- time constraints;
- coverage of the syllabus;

## Chapter 10

### **Conclusions and recommendations**

#### **Introduction**

Previous chapters have described the cases of Stephanie, Tiffany, Harry, Gaz and Patrick, five beginning teachers of mathematics in a primary school setting. Chapter 9 outlined the general themes, issues and dilemmas which emerged from the study of cases. This chapter uses that discussion to suggest tentative conclusions and recommendations. It begins with a summary of the research and a discussion of findings. It also outlines tentative implications for primary schools and other related groups, limitations of the study and concludes with recommendations for further research.

#### **Summary of the study**

The thesis describes the conduct and findings of an interpretivist, qualitative study into factors influencing the pedagogical practices of five beginning primary school teachers in their mathematics teaching. It also describes and evaluates a professional development and support model used with these beginning teachers.

From the available literature, critical elements of successful professional development and support for primary school teachers were identified. These were used, with account being taken for the needs, problems, and experiences of beginning primary school and, in particular, beginning teachers in mathematics, to form a model of support and professional development. Factors influencing the pedagogical practice of teachers and beginning teachers were also identified from the literature on teacher belief, and research into the first year of teaching. The study proceeded to determine the influence of factors in the specific cases of the project participants.

The participating teachers were interviewed and observed, in situ, over the period of their first year of teaching. Data were collected via reflective journals of participants,

transcribed interviews, transcribed case method meetings, repertory grids and a pre and post beginning year belief questionnaire. Analysis of the data was used to investigate factors, which influenced the beginning teacher's pedagogical practice and their pedagogical beliefs as well as to evaluate the effect of the support model on their pedagogical practice in mathematics.

The thesis has attempted to provide what Patton (1990) has called "thick description" by presenting, "sound, descriptive data". In this way "others reading the results can understand and draw their own interpretations" (p. 375). Such "thick description" has been provided, in many cases, by the inclusion of participants' own words, in which they express the meaning and beliefs behind their experiences. Thus, the thesis provides not only an interpretation of the research but also enables the reader to evaluate the potential appropriateness for other settings. It provides a description of the unique culture of each classroom. A classroom that is the product of what the actors bring to it (Nickson, 1992).

## **Findings of the study**

### **Research Question 1**

*To what extent do the following factors influence beginning teachers pedagogical practice in mathematics teaching: their own education, children in their class, their school experience, their beliefs about mathematics, mathematics teaching and learning, their teacher education, the school context, their knowledge of mathematics, other sources?*

Clarke (1995) noted that there was a need for detailed descriptions of the process of teacher change, with an emphasis on those factors that are seen to exert an influence on that change. He listed twelve factors that appeared to influence the process of changing teacher roles. His factors were:

- The reform movement,
- The principal and the school community,
- Internal support personnel,

- The spirit of collegiality, collaboration and experimentation,
- The grade level team of teachers,
- Innovative curriculum materials,
- The inservice programme,
- External support personnel,
- The researcher as audience and critical friend,
- Outcomes valued by the teacher,
- Day-to-day conditions under which teachers work,
- Teacher knowledge.

This research report provides examples of categories 9 and 11 as having an important influence on teacher development. While other factors from Clarke's list were present, for example teacher knowledge, they exerted only a minor influence in this study. Generally, they were dominated in a complex picture by the factors noted as important.

The findings show that the issue of survival was of paramount importance to all participants. In each case pedagogy was determined by the basic need to control the class and survive the initial terms of the first year. After the stage was completed, there were common factors such as the children in the classroom, as well as some individual and context-specific factors, for example, the availability of resources, which influenced what happened in the mathematics classroom. The factors influencing pedagogical practice in mathematics of beginning teachers in this study may be summarised as follows (see also Figure 10.1).

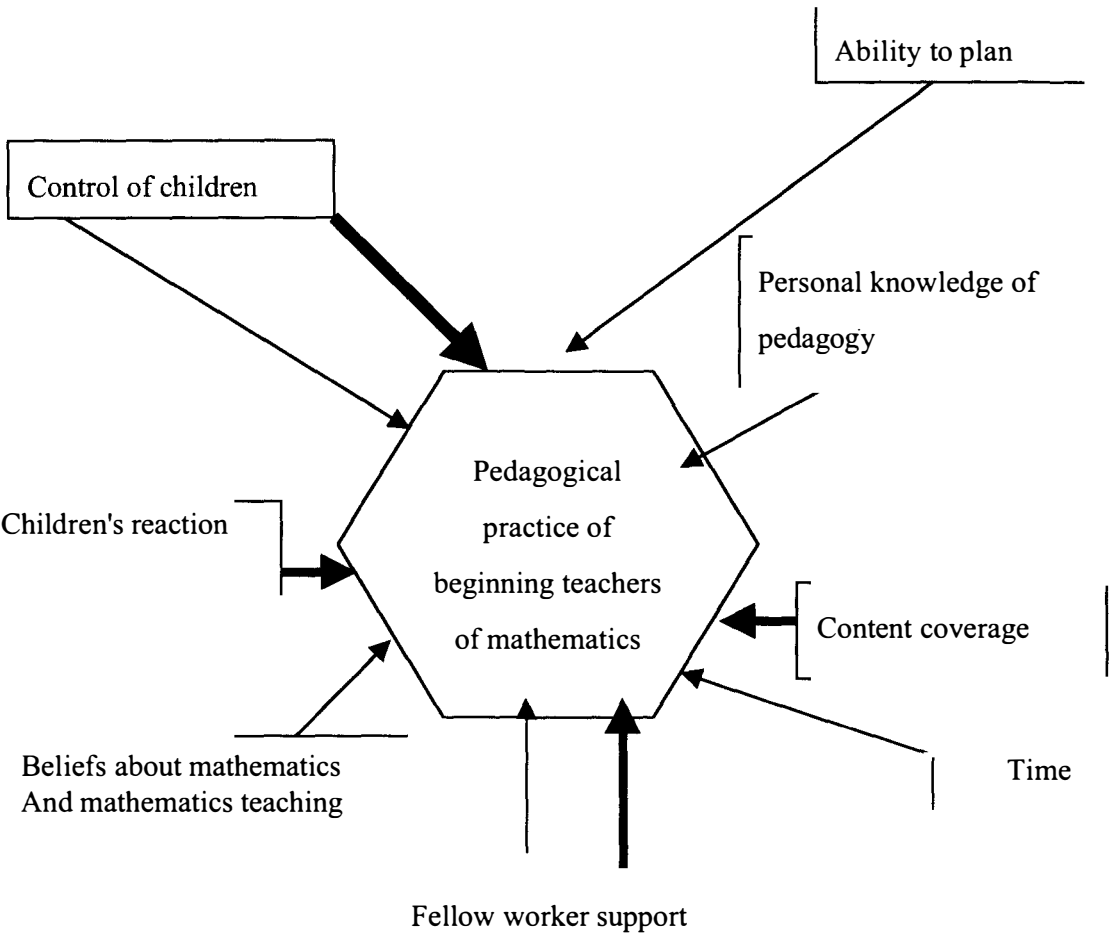
Major factor: control of the children in the class.

Important factors: personal beliefs about mathematics and mathematics teaching and learning, amount of time needed to accomplish things, personal knowledge and experience of a range of pedagogy, personal ability to plan and accommodate a range of abilities within the class, and the reactions of the children.


Minor factors: the teacher education course, school experience, availability of resources within the school, school context, their own education, and professional development.


The findings are consistent with those found by Raymond (1997), namely, that "mathematical beliefs and pupil behaviour had an overwhelming influence on teacher practice" (p. 573). The factor of control of the children diminished in importance during the year. In contrast, the influence of the 'fellow worker' support changed in the opposite direction and became a major factor in the post survival phase of the second half of the year. Hence, these factors are shown with two arrows in Figure 10.1.

**Figure 10.1 : Major factors influencing the pedagogical practice of beginning teachers of primary mathematics.**



Key:

Major influence 

Minor influence 

The main picture emerging from the data was that while one might be able to isolate factors for the purpose of discussion, the reality was that the factors were interrelated and presented a complex web. For example, the reaction of the children to mathematics was a factor but as soon as one started to analyse this then other factors, such as the school context, personal beliefs and pedagogical knowledge came into play. The focus or emphasis received by any one factor also varied between beginning teachers due to their particular circumstances. There was also variation in factor importance for the same teacher during the first year. For example, control of the class was a major focus of attention by the beginning teacher at the start of the year but was not so much of an issue as the beginning teacher's confidence and competence developed. Attending to the mixed ability nature of the children in the class was more a factor, towards the end of the year, for most of the teachers.

The main influence on their pedagogical practice for all the beginning teachers, especially in the first half of their beginning year, was that of controlling the behaviour of the children. This era or stage of survival is well reported in the literature (Burden, 1982; Katz, 1972; Ryan, 1994; Veenman, 1984) and lasts, according to the identified stages of development, between one and two years. In this reported study, the survival stage for the beginning teacher was present but lasted for a shorter period, approximately two terms or six months. Survival and control concerns overrode everything else during this stage and generally, resulted in a traditional teaching style being applied in the classroom for mathematics teaching. All participants experienced the 'reality shock', the 'adjustment phenomenon' and the 'transition shock' of moving from the relative calm of the teaching practice classroom to one for which they were fully responsible (Korthagan & Kessels, 1999; Veenman, 1984; Weinstein, 1988, 1998).

Many beginning teachers are not aware of this 'shock'. The employing authorities and universities could possibly do more to inform the novice teacher of this phenomenon so that they could accept this as normal. This information and realisation could reduce anxiety and stress for many beginning teachers. A feature of final semester units at university could be the compilation and discussion of strategies to overcome the 'reality shock' and to work toward development and change.



With the issue of 'entry shock' (Gill, 1998) noted a number of 'areas of uncertainty' for beginning teachers. These areas, found for the general beginning teacher population, are very consistent with the findings for this study related specifically to beginning teachers of primary mathematics. In particular Gill listed the following, all identified in the case studies of this report:

- Desire to be accepted by colleagues, and one's professional image,
- Anxiety about asking for help,
- Time—never enough,
- Difficulty with long term planning,
- Pre-occupation with discipline issues,
- Excessive attention to coverage of work, and
- Dependence on prepackaged materials.

In order to be able to control the children, the beginning teachers did not undertake anything that involved a risk of losing their control of the class. They removed, as far as possible, the chances for children to misbehave, by having a tightly structured lesson with the focus being on the teacher. Beginning teachers tended to adopt pedagogical practices, which involved individualised textbook or worksheet use, no pupil to pupil talk, procedural teaching from the teacher and an emphasis on the four operations of number. Tasks and a teaching style that gave quick, productive returns were employed so that the risk of failure was reduced (Brown & Borko, 1992; Kennedy, 1997; Raymond, 1997).

An integral part of the control issue was the children in the beginning teacher's class. They could, by their behaviour and reaction, either help or hinder the implementation of different pedagogical practices. The same phenomenon was identified by Rosenberg, Griffin, Kilgore and Carpenter (1997). They commented that the children were a more powerful influence than colleagues or supervisors. Most children were not used to working in mathematics in ways that were not traditional in style. Often a reaction to a change of practice was one of excitement and with it noise and possible misbehaviour. All of these things affected the fragile control of the beginning teacher. An adverse reaction, in the eyes of the beginning teacher, would mean that he or she would not try

the style of teaching in the short and possibly long term. They would remain within the comfort and control of a traditional approach. The need for control of the class, especially in the early part of the first year of teaching, meant that the beginning teachers adopted a traditional style of pedagogy.

On the other hand, if the children gave a positive reaction, the variation in pedagogical practice would be incorporated into the general way of working of the beginning teachers. They would be willing to repeat that experience or to try an experiment with another teaching style with the children. The confidence to experiment was a vital factor in the process of change and development and established one of the principles for change as identified by Clarke and Peter (1993). Kagan (1992) assigned significant influence to teachers' increasing knowledge and understanding of their children. As they found out more about children in their classes, they were able to reconstruct their knowledge of them and adopt different pedagogical practices to match the newly discovered demands. In this sense, the children, by means of their reactions and behaviour, were a major factor and influence on what the teachers did and how they did it in the mathematics classroom.

Time, or in reality a felt lack of enough time, was a factor in keeping the beginning teachers in a traditional style of teaching. It was a complex issue, with beginning teachers feeling that they did not have enough time to plan thoroughly, to find and organise resources and materials, to do lessons that are more open and to assess in ways other than pencil and paper testing.

The felt-need for syllabus or textbook coverage was a major factor in influencing pedagogical practice. All the beginning teachers noted syllabus coverage, but the strength of the factor varied between them. Coverage factors generally prompted the teachers to teaching styles and tasks that were quick. These favoured traditional approaches. Textbook use was adopted, in some cases, as it was not only time efficient but it also meant that parts of the syllabus were not missed, especially when the textbook was closely matched to the syllabus document. The textbook and the associated syllabus document also gave an impression to the beginning teachers that mathematics should be

taught as a series of small steps. By their nature and the fact that they have to be written, syllabus documents fragment mathematics into lesson-sized chunks for easy transmission.

The school context tended to be a minor factor in the pedagogical practice of the beginning teachers. There was no explicit evidence from the case studies to suggest that schools had exerted pressure on the teachers to adopt a particular pedagogical practice. There was, however, a feeling among the beginning teachers that they must, initially at least, work in certain ways. To do otherwise is 'risk taking'—not something most people are good at undertaking. There was a strong feeling of 'social heritage' and 'institutional tradition' (Mousley & Clements, 1990). These ways were traditional in style—the use of a particular textbook, paper and pencil testing, for example. The feeling came, in all cases apart from Harry, from implicit notions. Rarely, if ever, did they see colleagues teach but they did have a strong image of how a mathematics teacher teaches from their own education. Explicit instruction as to what to do and how to do it did not occur. The teachers did not experience a form of learning to teach which was an induction into institutional values and practices that predominated within the school (Calderhead & Shorrock, 1997). They did not become, in Lacey's (1977) term, institutionally compliant and pedagogically conservative. This may have happened had not the 'fellow worker' provided support, which helped the beginning teachers question what was happening within their classrooms. Schools did very little to interfere with or support the new teachers. Generally, the beginning teachers were left to teach and survive.

Limited pedagogical knowledge and experience became a restricting factor once the teachers moved beyond the control or survival stage. While they were often willing to work in non-traditional ways, they did not adopt such practices. The reason usually was they did not have the necessary pedagogical knowledge or experience of trying it or seeing it in practice. They might wish to work with game playing or assess in non-pencil and paper ways, but they were limited because they could not analyse the mathematical connections in games, or work out what the child knew from task assessment. They did not have deep enough conceptual knowledge to put into practice their beliefs about good mathematics teaching (Borko, Eisenhart, Brown, Underhill, Jones & Agard, 1992).

Evidence from the case studies in this study concurs with findings in the literature in that it suggests that their teacher education course had little obvious effect on pedagogical practice (Sullivan, 1989b; Weinstein, 1990). Most of the suggestions and important issues raised by the teacher education course had been 'filtered out', or not understood. Notes from the course were not consulted, knowledge was not applied and even major events on the course, for example a major assignment presentation on assessment strategies, were not remembered. Some shallow understandings were discussed, for example, the importance of using materials and activity for children but they were not applied to the classroom in the early stages of the beginning year. Stephanie and Tiffany spoke of these strategies throughout the year and, with support from the 'fellow worker' they used such pedagogical techniques with their classes later in the year. Harry, on the other hand, generally rejected the use of materials, problem solving and activity-based tasks for children.

Beliefs about mathematics and mathematics teaching were held, more strongly by some than others, and were quite resistant to change. The beliefs the beginning teachers held tended to be of a traditional orientation. They were reinforced by school practice and generally, what the beginning teachers saw around them. Even when such methods were shown to be less effective, as in the case of Gaz, teachers were most reluctant to move away from them. The issue of changing beliefs about pedagogical practice forms the focus of Research Question 2, which follows shortly.

The data suggest complex relationships between beliefs and pedagogical practice. As noted by Raymond (1997) a number of factors contributed to an inconsistency between direct belief-practice link. Their teaching style was governed much more by the sum of these factors. Elements within the immediate classroom situation, as discussed earlier, were the main causes of this inconsistency. The findings of this study were consistent with the assertion that although beginning teachers often enter the teaching profession with non-traditional beliefs about how they should teach, when faced with the constraints of actual classroom teaching, they tend to implement more traditional practices (Raymond, 1997). For teachers in this study there was a conflict between their deeply held beliefs about mathematics content and their surface beliefs about mathematics

teaching and learning (Kaplan, 1991). Generally, the deeply held, traditional beliefs predominated and perpetuated a more traditional style of mathematics pedagogy. This was particularly strong in the case of Harry. The influence of the 'fellow worker' acted to reduce this effect with Stephanie and Tiffany, while the children influenced the practice of Gaz. The influence of support or professional development, as used in this project, is not a factor identified by Raymond (1997) in her revised model of the relationships between mathematics beliefs and practices. The discussion of Research Question Three will argue that a support model for beginning teachers is another factor that can influence pedagogical practice and pedagogical belief.

For three of the case studies there was no influence from outside professional development, other than work with this project, because none was undertaken. In a situation where there was a felt lack of time, beginning teachers were reluctant to commit to something extra. Newer National and State documents relating to mathematical classroom practice had little influence on the beginning teachers. Such documents were somewhat unfamiliar to the teachers, or, in the case of Harry, dismissed as 'unworkable in the real world'. The issue of implementing reform-based teaching, whether from documents or from professional development courses presented a problem. Like Harry, many teachers and especially beginning teachers regarded the recommendations for classroom practice as unrealistic, given the constraints of the modern classroom and school system (Frykholm, 1999). The students in Frykholm's study cited issues of limited class time, curricular restraints, unruly or unmotivated students, lack of innovative resources and ideas, lack of knowledge about technology, and excessive planning as factors which made reform-based teaching unrealistic. Many of these impediments are highlighted in this study with beginning teachers. Gaz, on the other hand, used the syllabus, quite extensively as a teaching resource. The rest of the project group used a local textbook that was closely aligned to the syllabus document. They also used the syllabus scope and sequence chart as a checklist to monitor syllabus coverage.

These findings suggest that pedagogical practice in mathematics for beginning teachers was strongly influenced, initially, towards a traditional model by the teacher's need for control of behaviour in the classroom. They also had deeply rooted ideas of what

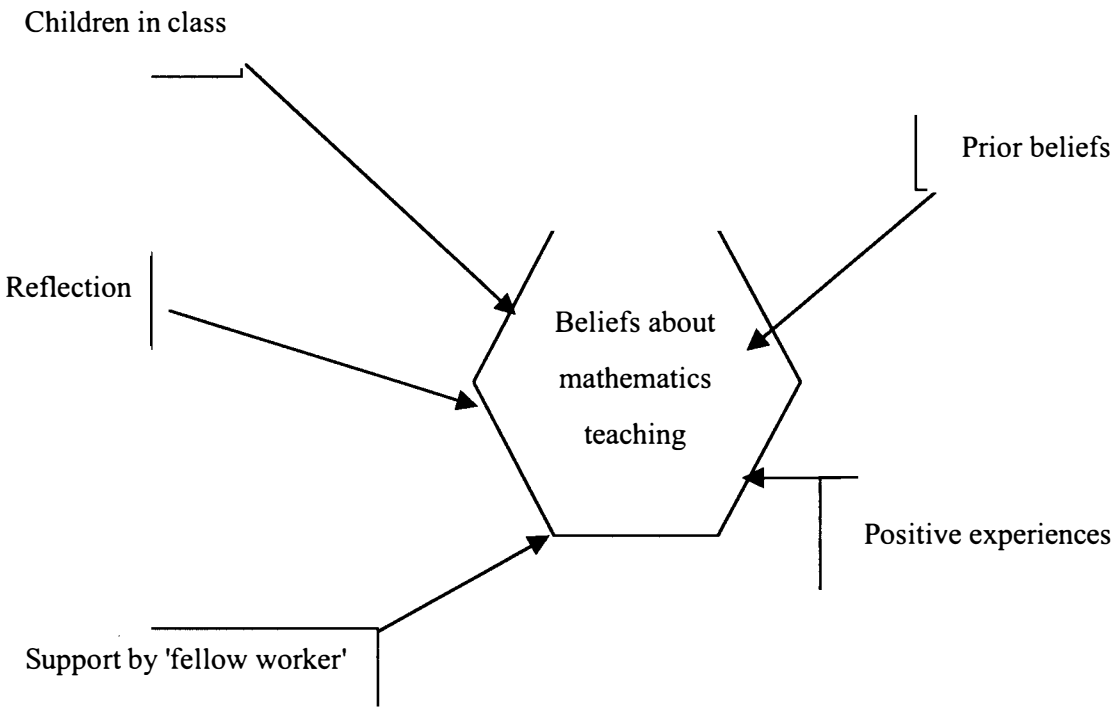
constituted traditional ways of working in mathematics classrooms. This was what they knew about and this was what they implemented in their classrooms. They began with a very simplistic concept of teaching (Rust, 1994). Once the beginning teachers moved beyond the initial survival phase, pedagogical practice tended to be influenced by the reaction of the children. In addition, lack of time, the need for coverage of the syllabus and a lack of pedagogical knowledge, steered them towards the maintenance of a traditional model of teaching mathematics. There was, however, a general move from *content-focussed with performance* to *content-focussed with conceptual understanding* by Gaz, Stephanie and Tiffany. None of the beginning teachers moved to a *learner-focussed, constructivist* viewpoint (Kuh & Ball, 1986). While these were general findings for the participants as a whole, it must be remembered that the impact of these factors varied with individuals and formed a complex, interrelated rather than a simplistic picture.

## Research Question 2

*To what extent do the following factors influence beginning primary teachers' pedagogical beliefs related to mathematics teaching: their own education, children in their class, their school experience, their teacher education, their knowledge of mathematics, the pedagogical knowledge, the researcher or other sources?* The second research question investigated influences on beginning teacher's beliefs about teaching mathematics.

The findings suggest that pedagogical beliefs were influenced to maintain already held beliefs. That is, many of the existing beliefs were reinforced during the beginning year of teaching. This was especially so if the beliefs were related to a traditional model of teaching. Findings also suggest, however, that aspects of these beliefs can be changed and that such changes can be maintained and built upon. Discussion of this aspect will occur in the section on findings for Research Question Three.

**Figure 10.2 : Major factors influencing the pedagogical beliefs of beginning primary mathematics teachers**



Findings suggest that beginning teachers in this study held, to varying degrees, traditional beliefs about mathematics teaching (see Figure 10.2). This finding concurs with the general research on preservice and teacher beliefs. Although it seems that beginning teachers' beliefs about mathematics teaching and learning are often altered through their preparation process at university (Ball, 1988a; Schram, Wilcox, Lappan & Lanier, 1989), it is equally clear that "many of their beliefs about mathematics teaching are in place before they begin their teacher education programs" and resurface when they begin teaching (Brown, Cooney & Jones, 1990). At different times, Gaz, Stephanie and Tiffany discussed aspirations to work in ways other than in a strictly traditional model. It may be suggested, however, that they were not convinced that other methods would be successful with their particular children. The power of their initial beliefs was very strong and difficult to influence.

Numerous factors combined to reinforce a belief in a traditional model for teaching. Experience and observations on teaching practice, as part of their teacher education course, showed, generally, a textbook or worksheet approach to mathematics teaching. Comments related to the general practice within their schools also highlighted the traditional nature of the practice. Their own mathematics education had followed a traditional model. What the beginning teachers saw and experienced led them to a traditional model of teaching mathematics and reinforced their belief that such a model was the correct one to use.

There was evidence of influences suggesting a non-traditional view of mathematics teaching, for example, Stephanie's memory of one of her teachers, from the researcher and, again in Stephanie's case, from a local Mathematics Advisory Teacher. These views were not, however, a factor in influencing the beginning teacher's pedagogical belief and practice in the first part of the year. Certainly, in the early months of the first year alternative ways of working and assessing were discussed, but were seen as 'not possible with my children'. Later in the year, however, when the survival period had been successfully negotiated, such factors as the researcher and personal school education, in combination with other factors, began to influence the beginning teachers' pedagogical beliefs. Any influence from their teacher education course was minimal initially on the beliefs of Gaz, Stephanie and Tiffany. They had aspirations to work in similar ways to strategies suggested in their course. There had been a little influence in this sense and towards the end of the first year these ideas were being accommodated in their beliefs about mathematics teaching. The traditional model had a strong hold on their beliefs and presented a barrier to change. Harry considered the teacher education course to be unrealistic and not relevant in many ways, and held his traditional belief about mathematics and mathematics teaching throughout the year.

As with pedagogical practice, it was the children who began to influence the pedagogical beliefs held by the beginning teachers. When the teachers were confident enough in their control of the class and started to try different ways of working, the reaction of the children was influential, not only on practice but also on beliefs about practice. A successful outcome, in which the children did not 'mess up' and had learned something,



brought new insights to the teacher. The participants were more inclined to repeat the pedagogical practice and perhaps try something else, when they experienced success. Gaz was a very good example. His belief about mathematics teaching was questioned, and eventually changed, due to the successful outcomes shown by the children. The opposite, that is poor outcomes from the children with a new way of working, was also a factor in confirming the prior, traditional belief. Harry attempted to work with materials, but the lesson was so unsuccessful that it confirmed his belief that the best way to teach mathematics was a traditional, teacher-led way. It is possible that Harry's strongly held belief in a traditional style of teaching meant that he did not believe that another way would be worthwhile or successful. His interpretation of the outcome did not meet his view of the world of mathematics and so he dismissed it as not useful. Stephanie and Tiffany were more open to other strategies for teaching mathematics. Initially, they thought other ways of working with children should be undertaken. This encouraged them to experiment with another teaching strategy. In some cases, they found that it was successful and was possible with their children. By repeating the teaching and reflecting on the outcomes, they came to realise that other ways of teaching were possible and in many instances were better. The model of change in beliefs outlined by Ellerton and Clements (1994) suggested that positive experiences, if repeated, would lead to change in attitude and belief. The cases of Stephanie, Tiffany and Gaz are examples of that phenomenon.

Teacher-held beliefs about their role may also have been influential in the change process. If, for example, the teachers viewed themselves as problem solvers then a different outcome could be expected from a view of self as executive. Here the teacher was seen as someone who was at the front of the class telling the children what was to be done and how it was to be completed. Problem solvers, on the other hand, would tend to take a tentative viewpoint and in considering a problem try out a strategy and adapt success to their teaching style. Stephanie, Tiffany and Gaz could be grouped in this category of problem solvers. Harry fell more into the category of self as executive. Here the belief was that the role was fixed and one should stay with it.

Findings from this research show that while beliefs about mathematical pedagogical practice are difficult to influence, it was the children in the classroom who exerted most power. Power, that is, to change or confirm beliefs.

Another factor that helped beginning teachers develop their teaching and question their beliefs was reflection on their practice. Reflection forms part of the next discussion related to Research Question Three and the professional development and support model.

### **Research Question 3**

*To what extent is an empowerment model of development, with 'fellow worker' support, an effective way to help beginning teachers develop as professional teachers?*

In order to answer Research Question Three it was necessary to analyse the tape transcripts, journals, questionnaires and repertory grids. The analysis needed to highlight aspects of the model—the action research cycle, the use of options, the role of the 'fellow worker'—as well as identifying change in classroom practice from the *teacher reflecting* sections.

As noted by Raymond (1997), the task of altering beliefs to mesh with the reform goals is a challenge for teacher educators. She proceeded to suggest that "early and continued reflection about mathematics beliefs and practices, beginning in teacher preparation, may be the key to improving the quality of mathematics instruction and minimising inconsistency between beliefs and practice" (p. 574). The support model designed and evaluated in this project accepted that challenge and used teacher reflection during the first year of teaching.

Findings from this project related to the empowerment model of professional development and support are offered as descriptions of what happened in this study. One cannot suggest firmly any 'cause and effect' relationship, or that this model developed more or superior change in teachers' practice than other models. No other models were tried for a comparison. The change noted may, in fact, be a natural part of the post-

survival stage of teacher development and have no relationship to the professional development model used in this project.

In general terms, the model for support was useful and effective in helping the beginning teachers survive their first year in teaching. All participants felt comfortable with the model and, in particular, with the visits of the 'fellow worker'. The visits were important in breaking the isolation experienced by the teachers. The model appeared to speed up the survival stage of the beginning teachers. The literature sets the survival stage lasting between one and two years (Burden, 1982; Katz, 1972). In this project, the participants had passed into the next stage after approximately six months. Participants were positive in their reaction to the individualised nature of the support and how they were offered options to help solve their particular problems and worries. The presence of the 'fellow worker' added a validity to their experimentation and made them feel more comfortable about taking risks by moving outside the traditional model of teaching.

Descriptions from the data show that there was change in practice towards styles and philosophies outlined in national and international documents for two of the cases—Stephanie and Tiffany. Data for Gaz were incomplete, though changes can be seen even in the short time he was with the project. Harry appeared to have changed little in his pedagogy and still held quite strong beliefs about a traditional style of teaching.

The next section of the discussion will outline findings related to each aspect of the empowerment model for support. That is, the action research cycle, teacher reflection, case methods meetings, the role of the 'fellow worker' and the empowerment aspect of the model.

### Action research cycle

This started well with individual problems for consideration being identified at the first meeting. A course of action was agreed but the beginning teachers did not put the next phase of the cycle into operation. Soon the formal action research cycle was abandoned in favour of a more informal method of discussion of problem issues. With hindsight, it could seem that, for the beginning teachers, the action research cycle had the appearance

of being yet another thing to do in a busy schedule. As was noted earlier in the findings from the project, the beginning teachers were trying to survive and were concerned about the lack of time to do everything they had to do. Thus, one extra thing was too much for them to accommodate. It did not or could not receive the necessary attention to put it into practice. It was left, therefore, incomplete by the teachers. It was not a priority for the teachers at that time. Johnston (1994) commented that action research in its formal sense was not a natural process for teachers in that it required them to be systematic and critical. The teachers in the project in the early part of their first year were concerned with control and did not have time to implement systematically new ideas. They were also inexperienced and new to reflection and critical appraisal of their teaching. The use of an informal narrative approach as adopted subsequently into the first year was more appropriate to their context and experience and was successful in highlighting issues for discussion (Chapman, 1993; Johnston, 1994a). Problems offered by the teachers for consideration were, with hindsight, not particularly focussed on their real problems, that is, class control and time issues. They set up problems that considered other issues. The options for solutions added to, rather than alleviated, their time and control concerns. Hence, they were left unresolved.

## Teacher reflection

The empowerment model design placed an emphasis on reflection on practice. This is an important aspect of the work of a professional teacher. It was approached in two ways—personal reflection via the written or audio taped journals and reflection with the ‘fellow worker’ during meetings at school. The reflective discussion with the ‘fellow worker’ was more successful than the teacher personal reflection. Edwards and Hensien (1999) in their study noted that it was readily apparent that ‘reflection and change go hand in hand’. They also noted that reflective practice is enhanced when the teachers’ efforts to reflect and reform are based on a foundation of collaborative support. The use of reflection enabled the beginning teachers to regain control of the teaching situation and comprehend it in better ways (LaBoskey, 1993). By means of reflection, Stephanie and Tiffany were able to ‘offset the conservative effects of the school’ (LaBoskey, 1993) and liberate themselves, to a certain extent, from the ‘unwarranted control of unjustified

beliefs' (Prawat, 1991). They began to move to 'pedagogical thinkers' (Feiman-Nemser & Buchmann, 1986).

The data suggest that supported reflection was a useful way to have teachers identify successful aspects of their teaching. The role of the 'fellow worker' in prompting the beginning teacher to reflect on and think about their teaching was important in developing their teaching. Reflection allowed the teacher to identify aspects of their practice that were effective in developing better learning with the children. Without the intervention of the 'fellow worker', these aspects almost certainly would have been missed. Bullough (1991) suggested that newly qualified teachers were frequently poor judges of their own performance. They react by being overly sensitive to parents, teachers and children. It was the reflection on successful aspects or positive experiences that were used as building blocks for further similar work in the classroom. This led on to change in pedagogical practices, and in some cases the pedagogical beliefs, in the classroom. The use of reflection on positive experiences from the classroom was used to influence the emotion or 'hot' end of the beliefs cycle held by the beginning teachers in the way advocated by Ellerton and Clements (1994). The repeated acknowledgment of positive emotional reactions to events acted to change beliefs held about pedagogical practice. As the practice of reflection on practice via prompts or questions from the 'fellow worker' developed, reflection became almost an automatic response in the teacher. In what could be seen as a metacognitive prompt, the beginning teacher would identify a positive aspect or aspects from the lesson upon which to comment in discussion with the 'fellow worker'. Data do not show if the idea of reflection moved from purely *reflection-on-practice* to *reflection-in-practice* (Schon, 1983). The latter being a useful technique for the effective teacher to employ in the day-to-day running of the classroom.

The other aspect of teacher reflection—the use of audio-taped journals was undertaken with mixed success. The two male teachers attempted the audio-taped journal, while one female teacher wrote her journal and one did not complete anything. The reflections that were completed—each week for term one by Gaz, aspects in term two by Harry—were very informative as to the thinking and decision making undertaken by the teachers. Journals

were incomplete or not attempted due to two reasons. Firstly, as with the action research cycle, it was an extra task, which needed to be completed in a busy schedule. Journal completion did not form a high priority for the teachers, and thus, tended to be forgotten or left for a later time. In term three, when a structure for the journal reflection (see Appendix 3) was offered upon which to 'hang' their reflections, more were completed. Comments from the teachers suggested that with the 'open response' journals they did not know what to say or understand what was wanted. The later structure gave them a start for their thinking and aided their writing and talking. Personal reflection also prepared the teachers for meetings with the 'fellow worker' and enabled them to think about their practice. This technique of reflecting on practice could be used when the catalyst of the 'fellow worker' was not present. The beginning teachers were more experienced with the technique and it could be used in effective and time efficient ways. Scaffolding, provided by the 'fellow worker', either in conversation or a written form, appeared to be a more effective way to engage the beginning teacher in reflection about their practice. This reflection led to a change in practice toward pedagogies recommended by research and recent documents.

### Case methods meetings

Comments from the teachers who attended case methods meetings suggested they were seen as valuable support mechanisms and helpful in thinking about mathematics teaching. The meetings were successful and supportive for those beginning teachers who were able to attend. However, as the meetings were held on a Saturday morning they cut into the personal life and responsibilities of the group. One member did not attend and another only managed to be present for the first meeting, due to family and personal commitments. The time aspect came into play again when group members were asked to read two short vignettes before the meeting. This reading was not completed and part of the meeting had to be given to it. The network aspect of the meeting was a useful and successful way to support the beginning teacher. It was a break into the loneliness and isolation of the first year experienced by the group. The meetings allowed the teachers also to acknowledge a degree of reality and commonality, in the sense that others were having similar experiences, feelings and difficulties. Aspects of success reported by other

members of the group at these meetings acted as a positive agent for change in practice. The report by a beginning teacher of a successful piece of teaching or the use of a method of working, often led to other members of the group trying that practice with their class. The fact that someone in a similar situation had been successful appeared to add credibility to the method.

### The role of the 'fellow worker'

Data suggest that this aspect of the project was successful. It was successful in that one could argue that the 'fellow worker' provided the support, experience and information required by the beginning teacher at the time and place of need. Veenman (1984) listed the perceived needs of beginning teachers as:

- Assistance with disciplining pupils,
- Motivating them,
- Dealing with individual differences,
- Assessing work,
- Dealing with parents,
- Organising class work, and
- Obtaining materials.

The 'fellow worker' was able to address the needs of each teacher as they worked through the first year. All aspects of Veenman's list occurred during the year for the teachers in the case studies, apart from dealing with parents.

The support of the 'fellow worker' was also another, and possibly most significant, way to break into the loneliness of the beginning teacher (Bolam, 1987). These options were not simple crisis management advice or dispensing 'tricks of the trade' for immediate but short-term solutions. The emphasis in the role of offering options for possible action and engaging the teacher in searching for ways forward, as well as reflecting on what had happened, found favour with the beginning teachers. The informal, almost take-it-or-leave-it, nature of the meetings fitted well with the circumstances of the first year out of university. It acknowledged the pressures and worries and did not force the participants

to do things against their will. Comments from the beginning teachers suggested that they did not want someone telling them what to do in their classroom, especially someone not familiar with their children and situation, as might be the case of an Education Department representative. The 'fellow worker' provided what Easen (1985) called 'a structure which helps others change' as people can only change themselves. The general feeling was that, while they were often aware of their shortcomings, they could do nothing about them immediately, and were not in sufficient control at the start of the year to undertake different teaching behaviours. The comments discussed earlier with regard to action research being seen as an extra to their priorities, offer a good example of this phenomenon.

Another significant aspect of the 'fellow worker' role was that it was not evaluative. There was nothing the participant or 'fellow worker' said or did that would lead to a final teaching mark. Before the end of the year, they would have to be appraised by the Principal so that they could receive their Education Department certification as a teacher. This was not linked to the study's requirements. The teachers felt they could be more open with the 'fellow worker' about their difficulties. Admitting to problems would not count against them in any appraisal they might undertake. The use of a mentor from within the school would possibly be of restricted effectiveness, as the feeling was suggested by the beginning teachers that any inadequacies shown might be inadvertently reported to the Principal. All participants noted that they were reluctant to ask colleagues for help for the reason of being seen as inadequate in their job. The 'fellow worker' filled the role of 'sounding board' for teaching successes and difficulties in the ways noted by Clarke (1996) and Feiman-Nemser (1992).

The 'fellow worker' role of causing or encouraging the teacher to reflect on what was happening or had happened in their class was most successful. Not only did it prepare teachers for and give them practice in reflection, it provided time and motivation for them to 'sit back' after the hustle and bustle of the classroom and contemplate exactly what had happened. The role was particularly important at the start of the year, in the survival stage. For many of the teachers at this stage, everything appeared to be failing or not going well. At the early meetings the 'fellow worker' asked for the teachers not only to



tell their stories but also to talk about parts they felt were successful. It was this aspect of highlighting the successes, which encouraged, as noted earlier with the Ellerton and Clements' cycle, the teachers to try that particular part again. Change and development was built on beginning teachers identifying successful practice and positive teacher experiences.

The 'fellow worker' role was useful to fill-in-the-gaps where the beginning teachers found their pedagogical knowledge was deficient. For change to take place, it was important for the beginning teacher to be supported with options of possible ways in which to overcome the problem. Intervention was individualised (Brown, Yeager, Rennells & Riley, 1997), thus, for Tiffany for example, help was offered with the connection between mathematical content and suitable games when she required that information. Frykholm (1999) noted a similar instance where preservice teachers were unable to make connections from their shallow knowledge of different ways of teaching to allow them to implement such methods in their classroom. The 'fellow worker' was able to offer help instantly. Obtaining help in this way did not rely on time and effort from the busy beginning teacher. Generally, they were too busy to find the necessary help and consequently the problem or issue remained unresolved. The use of the 'fellow worker' was quick and efficient.

### The professional development support model

The last point in the previous paragraph, that information was offered when and where it was required, was crucial to the success of the study in developing and supporting change. Each of the beginning teachers identified different problems for resolution and support during the year. The support model allowed these issues to be addressed at the time of need. The issues were specific and relevant to the teachers. Choice of topic allowed the beginning teachers to start rethinking their teaching of mathematics without creating a feeling of having it imposed on them (Cooney, 1996). A general, professional development model that addressed all beginning teachers in the same way could not meet this aspect of specialisation. This might match the need of some beginning teachers but would miss the mark for the majority. The feeling of ownership of the issue by the teachers and direct relevance to their particular classroom and children added an

important reality to the discussions. This professional development approach was a means to help teachers understand themselves, rather than judge them, and to help teachers understand practice, rather than dictate practice to them. The development was seen as an educative process (Robinson, 1989) with an emphasis on the teacher constructing meanings and knowledge and then acting on them (Richardson, 1994). Chapman (1999) identified this style of professional development and growth as a humanistic approach where the focus is on the teacher and not on a set of skills and teaching techniques.

The key to professional growth is the construction of personal meaning, which is self constructed and based on experience. Ignoring personal meaning trivialises teachers' ability to create their own classroom reality and is likely to stimulate resistance to change, rather than professional growth (Chapman, 1999).

Few examples of this approach are available in the literature on learning to teach. The report and findings of this project add to that literature. Stephanie's, Tiffany's, Harry's and Gaz's cases, along with others, can produce a coherent mosaic that can illuminate our more general understanding of the process of teacher change (Edwards & Hensien, 1999).

## **Implications and recommendations of the research**

One must be aware that, in the highly context-specific nature of this project, and in educational life in general, researchers cannot provide teachers and others with simplistic checklists or ready-made solutions to their particular problems. What is offered is, according to Eisner (1991), "considerations to be shared and discussed, reflected upon and debated" (p.205).

With research, such as reported here, it is the practitioner—the School Principal, the University teacher education lecturer, the beginning teacher and the employing department—who must judge the applicability of the findings and recommendations made to his or her own situation. There are a number of implications for practice in the findings of this project. The more salient ones are described below. Most relate directly at the

primary school level, others at the larger system and university level, although some will be of interest to beginning teachers at the individual level.

### The system level

From the findings of this study one becomes aware of the loneliness of beginning teachers—they are almost alone in the midst of a crowd. The beginning teachers in the study had, apart from Stephanie, no contact with anyone at the system level. The teachers were allocated to a school, and then left alone.

The teachers in the project and the others appointed to rural and remote schools in Western Australia were some of the best teachers to graduate from the teacher education system. They were arguably the best because the employing authority only took those graduate teachers with the top marks into their employment. They were, therefore, a most valuable resource, one that would form the backbone and leadership of the teaching force in the future, and one which should be protected and supported.

If the employing authority is serious about supporting and developing the best teachers for the ultimate benefit of children then strenuous efforts to combat the isolation of the beginning teacher should be made. The example from this study of the case methods meetings demonstrates the positive effect that sharing experiences with fellow beginning teachers can have.

A system for support of beginning teachers could be established which would not only help to counter the feelings of isolation but also aid the development of effective mathematics teaching, an area of hatred and fear for many teachers. The system while primarily aimed at mathematics would also have spin-offs into other curriculum areas from the feeling of confidence developed by the beginning teacher. The support system could be an experienced primary mathematics teacher who visited beginning teachers, in a similar way to the ‘fellow worker’, approximately twice a term. This person would also be a point of contact or help as needed by the teacher. The role would not be in any way evaluative—any evaluation of the beginning teacher would be undertaken by someone else, in order to separate the support and assessment domains.

The idea of an induction year or a probationary year for beginning teachers is not new. The Probationary Year has been revived in the United Kingdom (DFEE, 1998) and will be implemented from September 1999. The model offered, though, is an evaluative one, in that it has a list of standards, set by the Teacher Training Agency, for beginning teachers to achieve by the end of their first year of teaching. It does establish, however, a list of entitlements for beginning teachers, which mirror some of the successes of this study. These include mentoring by an experienced teacher, regular observation and feedback, regular discussions and target setting, identification of training needs, and membership of working groups within the school and networks of newly qualified teachers in the local area.

This is a huge investment of taxpayers' money to build appropriate support for beginning teachers. Ultimately, it will offer the community better value for money—it already invests a considerable amount to train teachers—as teachers will be better equipped to stay in the profession. They also will be more likely to reach their potential as excellent primary school teachers, not only of mathematics but all curriculum areas.

This study also highlights the huge pressures of balancing, appropriately, professional and personal life, as in the cases of Harry and Gaz. The two female members in the study, Stephanie and Tiffany, appeared less affected by the struggle. However, they were living for most of the time within easy reach of the close support of family and friends. This is not typical of most beginning teachers in Western Australian who are appointed to distant rural and often remote community schools. In these situations, beginning teachers have to adjust to the new teaching requirements as well as make a new life for themselves, often for the first time, away from the support of family and friends. The message is clearly stated by Morris (1999)

Too many of our new, young teachers have simply been left to cope with the demands of the classroom, without the support and guidance they have the right to expect (p. 21).

A result of this neglect is that many potentially excellent teachers leave the profession quickly, lose enthusiasm for it, or cope in less than effective ways. The result is often the

mis-match noted by the Department of Education, Employment and Training in Chapter One of this thesis.

## The university level

Aspects here are more difficult to identify. Certainly, however, there were common difficulties experienced by all the beginning teachers. The issues of mixed ability teaching, assessing the learning of children, survival and control and to a certain extent planning, existed at some time for all the beginning teachers in this study. It would appear that these are issues that should receive more attention in the University teacher education courses.

One of the issues of teacher education is to build programmes that educate and support teachers in changing their minds and practices to support more powerful mathematics and mathematics thinking for students (Lappan & Theule-Lubienski, 1994). Changing teachers' minds and beliefs about mathematics is difficult as shown by this reported study. They continued by suggesting that, "Additional work must be done to create environments in which these deeply held beliefs are challenged, examined and reconstructed" (p. 257). They envisaged a longer-term plan than solely preservice education with a connection to professional development programmes for teachers. The tenet, they noted was that in order to change their beliefs teachers need to see that the new approach works in their classroom. They saw a need for working models of support systems for novice teachers to be built (Lappan & Theule-Lubienski, 1994). This study offers an example of such a support system.

One should, however bear in mind the filtering effect of prior beliefs held by student teachers on the recommendations of teacher education courses. This phenomenon was apparent from all teachers in this study. New beliefs can be undone in a flash by a student teaching or beginning a job in a school whose culture promotes order in the classroom, teaching as telling, and standardised test results as the measure of teacher success (Lappan & Theule-Lubienski, 1994). The issue of school experience as part of a teacher education course is also of importance in maintaining or changing teacher belief and practice. Along with this issue is the need for beginning teachers to receive enough

practical advice and experience on how to implement non-traditional ways of teaching (Frykholm, 1999). Cooperating teachers are a significant influence on the development of thinking and teaching strategies (Zeichner & Gore, 1990). The placement process deserves further attention, as this is one of the places in which beginning teachers experience the implementation of reform teaching. The supervising lecturer has an important role to play in this situation as rarely do students experience a cooperating teacher who is teaching with non-traditional methods. Korthagen and Kessels (1999) noted the role of the university supervisor in developing a type of knowledge called *phronesis*. This is situation specific knowledge that is related to the context in which the problem is set. It brings knowledge that the student teacher has into personally relevant classrooms and develops connections between the two. The 'fellow worker' in this study undertook such a role with the beginning teachers, and provided an example of this method.

## The school level

All teachers in the study reported that their school did not have a policy or plan for inducting and supporting beginning teachers into the school. This was a further example of the isolation of beginning teachers. Each teacher taught in a classroom and had little or no reason to interact with colleagues. No school had in place a mentor system. The beginning teacher was left to get-on-with-it. It would be too much of a generalisation to suggest that it was a sink-or-swim policy that was actually in place but in some cases it came very close to being an actuality.

Each of the four main teachers in the study had not only a mixed ability class but also a multi-age class, and in the case of Harry, children from three different year groups. This situation added to the difficulties for developing effective practices quickly. Each teacher also worked full time with the children—Harry was only employed for four days a week so was not quite the same as the other teachers. There was occasional support from a teacher's aide or a specialist teacher, but generally the beginning teacher was in sole charge of the class.

The situation for four of the beginning teachers in this study was one of full time teaching with a mixed ability, multi-aged class of over thirty children. They did this on their own with little or no classroom support, little or no induction or professional development and at a time when they were struggling to survive their first few months of teaching. This is a most difficult situation to manage, even for an experienced teacher. It is a situation that the Teacher Training Agency in the United Kingdom has suggested should not exist for beginning teachers. They recommend that new teachers should not face 'unusual and unreasonable' demands such as classes larger or more unruly than typical of their school. They should only teach 90% of the average contact time for other teachers in the school. None of these recommendations were met in the reported case studies.

At the school level, the beginning teachers in this study would have been helped if there had been a planned policy for inducting a beginning teacher into the school. The plan needed to incorporate social as well as professional aspects of induction. The plan needed to be explicit and proactive in its approach rather than waiting for the beginning teacher to ask for help. As the study highlights, beginning teachers were reluctant to seek help. Professional support could have been offered. For example, joint planning with a teacher in a similar year group so that, as Tiffany noted, she would have seen how someone else planned for mathematics teaching. This strategy would allow the beginning teacher to see 'a way' to plan for mathematics, rather than telling them 'the way' to do it. In the early weeks of the year, beginning teachers would not have to search for or invent a planning system or style for planning. They would only have to produce the teaching content. Thus, one of the initial problems experienced by the teachers, that of appropriate planning, would be reduced.

Class size and make-up need consideration by the principal. Where possible, it would seem appropriate that the new teacher was given a single year group class. In this way the teacher would only have to plan for one year rather than juggling the issues raised by planning, managing and assessing two or more year groups in the same class. Non-teaching time needs to be considered for beginning teachers, possibly of the order of a day a week. They would then be able to plan better, attend professional development meetings and deal with issues that were prominent at the time.

The practice of presenting a beginning teacher with a mixed ability, multi-age, large class with no support in the form of time or people seems destined to perpetuate mediocre teaching and the loss of good teachers. Much of this is known already but steps to overcome the problem have not been taken. Evidence from this thesis points to the need for support for teachers at the individual and classroom level to develop their teaching and ultimately the quality of education of children.

## **The individual**

The feeling of isolation, of being left to get-on-with-it, was strong in the minds of the beginning teachers. They were apprehensive about other people seeing them work, and were conscious of the need to be seen to be doing a good job. Where possible, it would seem appropriate for them to contact, in an informed way, other beginning teachers to establish network meetings for the beginning teachers to share their experiences. From this study, teachers commented favourably on the chance to talk together at such things as the case methods meetings, to realise that other people were experiencing similar problems.

## **Limitations of the study**

The findings of this study suggest that the pedagogical practice in mathematics of beginning teachers can be changed with the aid of an appropriate professional development model, in this case, an empowerment model. However, some aspects of this study may have influenced the research in such a way as to reduce confidence in the findings.

As noted earlier, the study undertaken was small and the descriptions of events offered were context specific. While there are similarities arising from the cases they should not necessarily be seen as generalisable to all cases of beginning teachers of primary school mathematics.

A number of limiting factors and influences should be noted. The sample of beginning teachers was only four. Their selection was not random, because they were the only



subjects available. All teachers studied came from the same university, the same group and the same course—the Primary Graduate Diploma. For example, there were no students from a BEd course or with another university background. All students were within the larger metropolitan Perth area; there were no rural or remote examples.

In this study the ‘fellow worker’ was known to the participants, having been their university mathematics education tutor. This may have led to aspects of researcher influence in that the beginning teachers might have attempted to react in ways they thought he wanted. They would have gained an impression of his thoughts and pedagogical preferences from the interactions during their teacher education year.

## **Recommendations for further research**

The following recommendations for further research emanate from the tentative findings of this reported study.

The literature on teacher belief is well documented, but less is known of the beliefs about mathematics and mathematics teaching held by beginning teachers. This study has provided some information but more is needed concerning beginning teacher beliefs and how these beliefs are changed and maintained and their effect on pedagogical practice.

In this study, the children were a major influence on the pedagogical practices of the beginning teachers. Further research on how children can influence beliefs and practices, and how they can develop pedagogical change, could be undertaken. There is also scope here for considering how children could be included as part of a teacher education course to help beginning teachers with many of the issues related to assessment and pedagogy as noted in this study.

Work by Bullough (1991) has tracked teachers through their first few years of teaching. The present study, and most others, concentrated on only the first year of teaching. Research information about the development of beginning teachers of primary mathematics, post survival stage, in collaboration with the empowerment model of professional development would add useful data to the literature. The use of electronic media, for example, an interactive web site, to develop a network for early career

teachers may alleviate some of the aspects of isolation experienced by many beginning teachers. The evaluation of this form of support would add to the pool of information on teacher development and professional development support.

The present study describes beginning teachers with a Graduate Diploma in Primary Education background. Similar studies using BEd students, Early Childhood students or Secondary mathematics teachers would provide a richer picture of the first year of mathematics teaching.

This study recommends that a policy for the induction and support of beginning teachers, incorporating successful aspects of this study and other studies identified in this research, be introduced in Western Australian primary schools. The recommendation needs to be evaluated by studying beginning teachers and the effect of an induction policy on their mathematics teaching.

## **Postscript**

The vision of mathematics teaching captured by the reform documents represents a change from the image of a traditional mathematics classroom with teacher-directed, textbook learning. Fostering such changes demands an understanding of the processes by which teachers change their pedagogical practices.

Given the vision of mathematics instruction animating the reform effort, teacher development—teachers constructing for themselves a new mathematics pedagogy—is at the heart of that vision (Edwards & Hensien, 1999, p. 16).

This thesis has provided a specific example of that teacher development with beginning teachers of primary mathematics.

## References

- Adler, J. (1996). Lave and Wenger's social practice theory and teaching and learning school mathematics. In L. Puig & A. Gutierrez (Eds.) *Proceedings of the 20th International Conference for the Psychology of Mathematics Education*, Valencia, Spain (pp. 2.3-2.10). University of Valencia: PME.
- Aguirre, J.M., Haggarty, S.M., & Linder, C.J. (1990). Student teachers' conceptions of science teaching and learning: A case study in preservice science education. *International Journal of Science Education*, 12, 381-390.
- Ainley, J. (1996). Being a researcher and being a teacher. In L. Puig & A. Gutierrez (Eds.) *Proceedings of the 20<sup>th</sup> International conference for the Psychology of Mathematics Education, Valencia, Spain* (pp. 2.11-2.18). University of Valencia: PME.
- Anderson, D., & Piazza, J. (1996). Changing beliefs: Teaching and learning mathematics in constructivist preservice classrooms. *Action in Teacher Education*, 18(2), 51-62.
- Anderson, E.M., & Shannon, A.L. (1988). Toward a conceptualisation of mentoring. *Journal of Teacher Education*, 39(1), 38-42.
- Australian Council of Deans of Education (1998). *Preparing a profession: Report of the National Standards and Guidelines for Initial Teacher Education Project*. Canberra: Author.
- Australian Education Council, (1991). *A national statement on mathematics for Australian schools*. Carlton, Victoria: Curriculum Council.
- Ball, D. L. (1988a). *The subject matter preparation of prospective mathematics teachers: Challenging the myths* (Research Report No. 88-3). The National Center for Research on Teacher Education.
- Ball, D. L. (1988b). Unlearning to teach mathematics. *For the Learning of Mathematics*, 8(1), 40-48.
- Ball, D. L. (1988c). *Research into teaching mathematics: Making subject matter knowledge part of the equation*, (Research Report No. 88-2). The National Center for Research on Teacher Education.
- Ball, D. L. (1992). Teaching mathematics for understanding: What do teachers need to know about the subject matter? In M. Kennedy (Ed.) *Teaching academic subjects to diverse learners*, (pp. 63-83). New York: Teachers' College Press.
- Ball, D. L., & McDiarmid, G. W. (1989). *The subject matter preparation of teachers* (Research Report No. 89-4). The National Center for Research on Teacher Education.
- Ball, D. L., & Feiman-Nemser, S. (1988). Using text books and teachers' guides: A dilemma for beginning teachers and teacher educators. *Curriculum Inquiry*, 18(4), 401-423.
- Barnett, C. (1992). Building a case-based curriculum to enhance the pedagogical content knowledge of mathematics teachers. *Journal of Teacher Education*, 42(4), 1-9.

- Barnett, C., & Friedman, S. (1997). Mathematics Case Discussions: Nothing is Sacred. In E. Fennema & B. Scott-Nelson (Eds.), *Mathematics Teachers in Transition*, (pp. 381-399). New York: Lawrence Erlbaum Associates.
- Barnett, C., Goldenstein, D., & Jackson, B. (1994). *Fractions, Decimals, Ratios and Percents: Hard to teach and hard to learn*. Portsmouth, NH: Heinemann.
- Barnett, C., & Ramirez, A. (1995). Fostering critical analysis and reflection through mathematics case discussions. In J. Colbert, P. Desberg & K. Trimble (Eds.), *The case for education: Contemporary approaches for using case methods*, (pp. 1-13). New York: Allyn & Bacon.
- Barnett, C., & Sather, S. (1992). Using case discussions to promote changes in beliefs among mathematics teachers. *Paper presented at the Annual Conference of the American Educational Research Association*. San Francisco: AERA.
- Barnett, C., & Tyson, P. (1993a). Case methods and teacher change: Shifting authority to build autonomy. In B. Atweh, C. Kanes, M. Carss, & G. Booker (Eds.), *Contexts in mathematics education*, (pp. 75-83). Brisbane: Mathematics Education Research Group of Australasia.
- Barnett, C., & Tyson, P. (1993b). Mathematics teacher cases as a catalyst for informed strategic enquiry. *Paper presented at the Annual Conference of the American Educational Research Association*. Atlanta, Georgia: AERA.
- Barnett, C., & Tyson, P. (1995). From teacher to student and back again: Evaluating math case teacher professional development based on student thinking and interactions. In D. Clarke (Chair), *Examining the impact of math case discussions on teachers, classrooms and students*. Paper presented at the Annual meeting of the American Educational Research Association, San Francisco.
- Baroody, A. (1987). *Children's mathematical thinking*. New York: Teachers College Press.
- Begg, A. (1996). Mathematics education: Empowerment or disempowerment? In P. Clarkson (Ed.) *Technology in mathematics education. Proceedings of the 19<sup>th</sup> Annual Conference of the Mathematics Education Research Group of Australasia*, (pp. 11-21). Melbourne: MERGA.
- Belenky, M. F., Clinchy, B., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice and mind*. New York: Basic Books Inc.
- Berlak, A. & Berlak, H. (1981). *Dilemmas of schooling: Teaching and social change*. New York: Methuen.
- Board of Teacher Registration (1991). *Welcoming new teachers: Report of the working party on the induction of provisionally registered teachers*. Toowong, QLD: Board of Registration.
- Bobis, J., & Cusworth, R. (1995). Attitudinal shifts towards mathematics of preservice teachers. In B. Atweh & S. Flavel (Eds.), *GALTHA, 18th Annual Conference of the Mathematics Education Research Group of Australasia*, (pp. 109-114). Darwin: MERGA.
- Bolam, R. (1987). Induction of beginning teachers. In M.J. Dunkin (Ed.) *The international encyclopedia of teaching and teacher education*, (pp. 745-757). Oxford: Pergamon.

- Borko, H., Eisenhart, M., Brown, C., Underhill, R., Jones, D., & Agard, P. (1992). Learning to teach hard mathematics. Do novice teachers and their instructors give up too easily? *Journal of Research in Mathematics Education*. 23(3), 194-222.
- Borko, H., & Puttnam, R. (1998). Professional development and reform-based teaching. *Teaching and Teacher Education*. 14(1), 1-3.
- Brickhouse, N.W., & Bodner, G.M. (1992). The beginning science teacher: Classroom narratives of convictions and constraints. *Journal of Research in Science Teaching*, 29(5), 471-485.
- Brooks, J.G., & Brooks, M.G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: Association of Supervision and Curriculum Development.
- Brookfield, S. (1987). *Developing Critical Thinkers*. San Francisco: Open University Press.
- Brown, C., & Borko, H. (1992). Becoming a mathematics teacher. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*, (pp. 209-242). New York: Macmillan.
- Brown, C., Stein, M., & Forman, E. (1996). Assisting teachers and students to reform the mathematics classroom. *Educational Studies in Mathematics*, 31, 63-93.
- Brown, J.G., & Brooks, M.G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Brown, S., Cooney, T.J., & Jones, D.L. (1990). Mathematics teacher education. In W.R. Houston, M. Haberman, & J. Sikula (Eds.), *Handbook of Research on Teacher Education*, (pp. 639-656). New York: Macmillan.
- Brownell, M., Yeager, E., Rennells, M., & Riley, T. (1997). Teachers working together: What teacher educators and educators should know. *Teacher Education and Special Education*. 20(4), 340-359.
- Buchmann, M. (1987). *Teacher knowledge: The light teachers live by*. (Issue paper No. 87-1). E. Lansing, MI: Michigan State University, Institute for research on teaching.
- Bullough, R. (1989). *First year teacher: A case study*. New York: Teachers College Press.
- Bullough, R. (1990). Supervision, mentoring and self-discovery: A case study of a first year teacher. *Journal of Curriculum Supervision*. 5(4), 338-360.
- Bullough, R. (1991). Exploring personal teaching metaphors in preservice teacher education. *Journal of Teacher Education*. 43, 453-465.
- Bullough, R., & Baughmann, K. (1993). Continuity and change in teacher development: First year teacher after five years. *Journal of Teacher Education*. 44(2), 86-95.
- Bullough, R., & Baughmann, K. (1995). Changing contexts and expertise in teaching: First year teacher after seven years. *Teaching and Teacher Education*. 11(5), 461-477.
- Bullough, R.V., Knowles, J.G., & Crow, N.A. (1991). *Emerging as a teacher*. London: Routledge.

- Burden, P.R. (1982). *Developmental supervision: Reducing teacher stress at different career stages*. Paper presented at the Annual Conference of the Association of Teacher Educators, Phoenix, Arizona.
- Burk, D.I., & Fry, P.G. (1997). Autonomy for democracy in a primary classroom: A first year teacher's struggle. *Teaching and Teacher Education*, 13(6), 645-658.
- Calderhead, J. (1988). The development of knowledge structures in learning to teach. In J. Calderhead (Ed.) *Teachers' professional learning*, (pp. 51-64). London: The Falmer Press.
- Calderhead, J. (1989). Reflective teaching and teacher education. *Teaching and Teacher Education*, 5(1), 43-51.
- Calderhead, J. (1993). The contribution of research on teachers' thinking to the professional development of teachers. In C. Day, J. Calderhead & P. Denicolo (Eds.) *Research on teacher thinking: Understanding professional development*, (pp. 11-18). London: The Falmer Press.
- Calderhead, J., & Robson, M. (1991). Images of teaching: Student teachers' early conceptions of classroom practice. *Teaching and Teacher Education*, 7(1), 1-8.
- Calderhead, J., & Shorrock, S. (1997). *Understanding teacher education: Case studies in the professional development of beginning teachers*. London: The Falmer Press.
- Carter, K., & Doyle, W. (1996). Personal narrative and life history in learning to teach. In J. Sikula (Ed.) *Handbook of Research on Teacher Education* (2<sup>nd</sup>. Edition), (pp. 120-142). New York: Macmillan.
- Chapman, O. (1993). Facilitating in-service mathematics teachers' self-development. In Hirabayashi (Ed.), *17th Conference of the International group for the Psychology of Mathematics Education*, (Vol 1 pp. 228-235). Tsukuba, Japan: PME.
- Chapman, O. (1999). Inservice teacher development in mathematical problem solving. *Journal for Mathematics Teacher Education*, 2, 121-142.
- Clandinin, J. (1989). Developing rhythm in teaching: The narrative study of a beginning teacher's personal practical knowledge of teaching. *Curriculum Inquiry*, 19(2), 121-141.
- Clandinin, J., & Connelly, M. (1996). Teachers' professional knowledge landscapes: Teachers' stories—stories of teachers—school stories—stories of schools. *Educational Researcher*, 25(3), 24-30.
- Clarke, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching*, (pp. 255-296). New York: Macmillan.
- Clarke, B. (1996). Expecting the unexpected: Professional growth through the highlights and challenges of a problem solving classroom. In P. Clarkson (Ed.) *Technology in mathematics education. Proceedings of the 19<sup>th</sup> Annual Conference of the Mathematics Education Research Group of Australasia*, (pp. 123-130). Melbourne: MERGA.
- Clarke, D. (1990). *Mathematical behaviour and the transition from primary to secondary school*. Unpublished Doctoral Dissertation. Monash University.

- Clarke, D., & Hollingsworth, H. (1994). Reconceptualising teacher change. In G. Bell, B. Wright, N. Leeson, & J. Geake (Eds.), *Challenges in mathematics education: Constraints on construction. 17th Annual Conference of the Mathematics Education Research Group of Australasia*, (Vol 1 pp. 153-163). Lismore, NSW: MERGA
- Clarke, D. J., & Peter, A. (1993). Classroom experimentation and teacher reflection in a dynamic model of professional growth. *Paper presented at the Annual Conference of the American Educational Research Association*. Atlanta, Georgia: AERA.
- Clarke, D. M. (1994). Ten key principles from research for the professional development of mathematics teachers. In D. B. Aichele & A. F. Coxford (Eds.), *Professional development for teachers of mathematics - 1994 Yearbook*, (pp. 37-48). Reston, Virginia: National Council of Teachers of Mathematics.
- Clarke, D. M. (1995). Changing teacher roles. In A. Richards (Ed.), *FLAIR - 15th Biennial Conference of the Australian Association of Mathematics Teachers*, (pp. 178-183). Darwin: AAMT.
- Clarke, D. M. (1996). The changing role of the mathematics teacher. *Journal for Research in Mathematics Education*, 28, 278-306.
- Cobb, P. (1989). Experiential, cognitive and anthropological perspectives in mathematics education. *For the Learning of Mathematics*, 9 (2), 32-42.
- Cobb, P. (1994). Where is the mind? Constructivist and sociocultural perspective on mathematics development. *Educational Researcher*, 23(7), 13-20.
- Cobb, P., Wood, T., & Yackel, E. (1990). Classrooms as learning environments for teachers and researchers. In R. Davis, C. Maher, & N. Noddings (Eds.), *Constructivist views on teaching and learning mathematics*. Journal for Research in Mathematics Education monograph, (pp. 125-146). Reston, VA: NCTM.
- Cochran-Smith, M. (1991). Reinventing student teaching. *Journal of Teacher Education*, 42(2), 104-118.
- Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19(5), 2-14.
- Cooney, T. (1985). A beginning teacher's view of problem solving. *Journal for Research in Mathematics Education*, 16(5), 324-336.
- Cooney, T. (1994). Research and teacher education: In search of common ground. *Journal for Research in Mathematics Education*, 25(6), 608-636.
- Cooney, T. (1996). *Conceptualising the professional development of teachers*. Keynote paper presented at the 8<sup>th</sup> International Congress of Mathematics Education, Seville, Spain.
- Curriculum Council (1998). *Curriculum Framework*. Osborne park, WA: Curriculum Council of Western Australia.
- Denzin, N.K. (1989). *The research act: A theoretical introduction to sociological methods* (3<sup>rd</sup> edition). Englewood, NJ: Prentice Hall.
- Department for Education and Employment (1998). *Induction for new teachers*. Suffolk: DFEE publications.

- Department of Employment, Education, and Training. (1989). *Discipline review of teacher education in mathematics and science*. Canberra: Author.
- Department of Education and Science. (1982). *Mathematics Counts. The Cockcroft Report*. London: HMSO.
- Department of Education and Science. (1991). *Mathematics in the National Curriculum*. London: HMSO.
- Desforges, C., & Cockburn, A. (1987). *Understanding the mathematics teacher: A study of practice in First schools*. London: Falmer Press.
- Dowding, G. (1998). Beyond survival: Supporting beginning teachers through effective induction. *The Practising Administrator*, 20(2), 18-20.
- Doyle, W. (1990). Case methods in the education of teachers. *Teacher Education Quarterly*, 17(1), 7-15.
- Easen, P. (1985). *Making school-centred INSET work*. Beckingham: Croom Helm.
- Education Department of Western Australia (1998). *Student Outcome Statements for Western Australian schools*. East Perth: EDWA.
- Edwards, T.G. (1996). Implications of a model for conceptualising change in mathematics teachers' instructional practices. *Action for Teacher Education*. Vol. xviii (2), 19-30.
- Edwards, T.G., & Hensien, S.M. (1999). Changing instructional practice through action research. *Journal of Mathematics Teacher Education*, 2, 187-206.
- Eisner, E.W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. New York: Macmillan.
- Ellerton, N.F. (1996). Mathematics teacher development: An alternative scenario. In L. Puig, & A. Gutierrez (Eds.) *Proceedings of the 20<sup>th</sup> Conference of the International Group for the Psychology of Mathematics Education* (Addenda, 13-23). Valencia, Spain: PME
- Ellerton, N.F., & Clements, M.A. (1994). *Fostering mathematical attitudes and appreciation*. Adelaide: Australian Association of Mathematics Teachers.
- Ellerton, N.F., & Clements, M.A. (1996). Research and Practice: A symbiotic relationship. Paper presented at *Partnership in teacher development for a new Asia*. Bangkok: UNESCO-ACEID/UNICEF.
- Ellerton, N.F., Clements, M.A., & Skehan, S. (1989). Action research and the ownership of change: A case study. In N.F. Ellerton & M.A. Clements (Eds.), *School mathematics: The challenge to change*, (pp. 284-302). Geelong, Victoria: Deakin University.
- Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching*, 15(1), 13-33.
- Elliott, J. (1978). What is action research in schools? *Journal of Curriculum Studies*, 10(4), 355-257.
- Feiman-Nemser, S. (1983). Learning to teach. In L.S. Shulman & G. Sykes (Eds.) *Handbook of teaching and policy*, (pp. 150-170). New York: Longman.



- Feiman-Nemser, S. (1992). *Helping novices learn to teach: Lessons from an experienced support teacher*, (Research report No. 91-6). National Center for Research on Teacher Education, Michigan State University.
- Feiman-Nemser, S., & Buchmann, M. (1986). The first year of teacher preparation: Transition to pedagogical thinking. *Journal of Curriculum Studies*, 18(3), 239-256.
- Feiman-Nemser, S., & Buchmann, M. (1989). Describing teacher education: A framework and illustrative findings from a longitudinal study of six students. *The Elementary School Journal*, 89(3), 365-377.
- Feiman-Nemser, S., & Featherstone, H. (Eds.) (1992). *Exploring teaching: Reinventing an introductory course*. New York: Teachers College Press.
- Feiman-Nemser, S., & Floden, R.E. (1986). A consumer's guide to teacher development. *Journal of Staff Development*, 1(2), 126-147.
- Feiman-Nemser, S., & Parker, M.B. (1993). Mentoring in context: A comparison of two U.S. programs for beginning teachers. *International Journal of Educational Research*, 19(8), 699-718.
- Fennema, E., & Sherman, J.A. (1976). Fennema-Sherman Mathematics Attitude Scales: Instruments designed to measure attitude toward the learning of mathematics by males and females. *Journal of Research in Mathematics Education*, 7, 324-326.
- Fessler, R., & Christensen, J.C. (1992). *The teacher career cycle: Understanding and guiding the professional development of teachers*. Boston: Allyn & Bacon.
- Fetherstonhaugh, T. (1994). Using the Repertory Grid to probe students' ideas about energy. *Research in Science and Technology Education*, 12(2), 117-127.
- Fetherstonhaugh, T. (1995). *Using Repertory grids in classrooms*. Perth: Mathematics, Science and Technology Education Centre.
- Firestone, W.A. (1987). Meaning in method: The rhetoric of quantitative and qualitative research. *Educational Researcher*, 16, 16-21.
- Frid, S., & Malone, J. (1995). Negotiating meaning in mathematics classrooms: A study of two Year 5 classes. *Mathematics Education Research Journal*, 7(2), 132-147.
- Frank, M. (1990). What myths about mathematics are held and conveyed by teachers? *The Arithmetic Teacher*, January.
- Frykholm, J.A. (1999). The impact of reform: Challenges for mathematics teacher preparation. *Journal for Mathematics Teacher Education*, 2, 79-105.
- Frykholm, J. (1998). Beyond supervision: Learning to teach mathematics in community. *Teaching and Teacher Education*, 14(3), 305-322.
- Gann, J. H. (1993). Making change in schools. *Arithmetic Teacher*, 40(5), 286-289.
- Galbo, C. (1998). Helping adults learn. *Thrust for Educational Leadership*, 27(7), 13-15, 35.
- Gallos, F., & Herrington, T. (1999). The effectiveness of a school-based professional development program for secondary mathematics teachers in the Phillipines. *Journal of Science and Mathematics Education in SE Asia*, xx(2), 48-58.

- Gill, M. (1998). Beginning teachers as experts in the making. *English in Australia*, 122, 94-103.
- Gold, R.L. (1969). Roles in sociological field observation. In G. McCall & J.L. Simmons (Eds.), *Issues in participant observation*, (pp. 30-39). Reading, MA: Addison-Wesley.
- Gold, Y. (1996). Beginning teacher support. In J. Sikula (Ed.) *Handbook of Research on Teacher Education*, (pp. 548-549). New York: Association of Teacher Education.
- Gordon, A., & Tyson, P. (1995). Assessing the impact of mathematics case methods on teacher practices. *Paper presented at the Annual conference of the American Educational Research Association*, San Francisco: AERA.
- Gratch, A. (1998). Beginning teacher and mentor relationships. *Journal of Teacher Education*, 49(3), 220-227.
- Griffin, G.A. (1989). A descriptive study of student teaching. *Elementary School Journal*, 89, 343-364.
- Grundy, S. (1996). Building professional research partnerships: Possibilities and perplexities. *Australian Educational Researcher*, 23(1), 1-15.
- Grundy, S. (1998). Action research. In B. Down, C. Hogan & P. Swan (Eds.) *Reclaiming professional development: New ways of thinking about teachers learning*, (pp. 15-26). Perth: Murdoch University.
- Guba, E.G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Technology Research and Development*, 29(2), 75-91.
- Guskey, T.R., & Huberman, M. (1995). *Professional development in education: New paradigms and practices*. New York: Teachers College Press.
- Hargreaves, A. (1992). Cultures of teaching: A focus for change. In A. Hargreaves & M. Fullen (Eds.) *Understanding Teacher Development*, (pp. 216-240). New York: Teachers College Press.
- Hart, A.W. (1989). *Role politics and the redesign of teachers' work*. Salt Lake City: University of Utah.
- Herman, W. (1998). Promoting pedagogical reasoning as preservice teachers analyse case vignettes. *Journal of Teacher Education*, 49(5), 391-397.
- Herrington, J. (1997). *Authentic learning in interactive multimedia environments*. Unpublished Doctoral Dissertation. Edith Cowan University.
- Herrington, T., Sparrow, L., Herrington, J., & Oliver, R. (1997). *Investigating assessment strategies in mathematics* [CD ROM]. Perth: Mathematics, Science and Technology Education Centre.
- Herrington, T., Sparrow, L., & Swan, P. (1995). Professional development: whose problem is it anyway? In B. Atweh & S. Flavel (Eds.), *GALTHA - 18th Annual Conference of the Mathematics Education Research Group of Australasia*, (Vol 1 pp. 338-345). Darwin: MERGA.
- Hill, L. (1997). Just tell me the rule: Learning to teach elementary mathematics. *Journal of Teacher Education*, 48(3), 211-221.

- Hogan, C. (1997). Reclaiming professional knowledge: Teachers' stories as professional development. In J. Smyth (Ed.), *Teaching and Teachers' Work*, 5(4), 1-4.
- Hogan, C. (1998). The use of professional journalling in teaching. In B. Down, C. Hogan, & P. Swan (Eds.) *Reclaiming professional knowledge: New ways of thinking about teachers learning*, (pp. 26-31). Perth: Murdoch University.
- Hogan, C., & Down, B. (1998). Acknowledging professional lives: A case study in rethinking teacher education. In B. Down, C. Hogan, & P. Swan (Eds.) *Reclaiming professional knowledge: New ways of thinking about teachers learning*, (pp. 51-59). Perth: Murdoch University.
- Hollingsworth, S. (1989). Prior beliefs and cognitive change in learning to teach. *American Educational Research Journal*, 26(2), 160-189.
- Hollingsworth, S., Dybdahl, M., & Minarek, L.T. (1993). By chart and chance and passion: The importance of relational knowing in learning to teach. *Curriculum Inquiry*, 23(1), 5-35.
- Huberman, M. (1995). Networks that alter teaching teachers and teachers. *Theory and Practice*, 1, 193-212.
- Huling-Austin, L. (1990). Teacher induction programs and internships. In W.R. Houston, M. Haberman, & J. Sikula (Eds.), *Handbook of research on teacher education*, (pp. 535-548). New York: Macmillan.
- Jalongo, M., & Isenberg, J. (1995). *Teachers' stories: From personal narrative to professional insight*. San Francisco: Jossey-Bass.
- Jaworski, B. (1993). The Professional development of teachers—the potential of critical reflection. *British Journal of Inservice Education*, 19(3), 37-42.
- Jaworski, B., & Watson, A. (1994). *Mentoring in mathematics teaching*. London: Falmer Press.
- Johnson, N.J., & Owen, J.M. (1986). The two cultures revisited: Integrating messages from models of teaching and clinical supervision to encourage improvement in teaching. *Paper presented at the Annual Conference of the Australian Educational Research Association, Melbourne*.
- Johnson, N., Ratsoy, E., Holdaway, E., & Friesen, D. (1993). The induction of teachers: A major internship program. *Journal of Teacher Education*, 44(4), 296-304.
- Johnston, S. (1993). Action research as a school level change process. *Curriculum Perspectives*, 13(1), 21-28.
- Johnston, S. (1994a). Is action research a natural process for teachers? *Educational Action Research*, 2(1), 39-47.
- Johnston, S. (1994b). Experience is the best teacher, or is it? An analysis of the role of experience in learning to teach. *Journal of Teacher Education*, 45(3), 199-208.
- Johnston, S., & Proudford, C. (1994). Action research—Who owns the process? *Educational Review*, 46(1), 3-14.
- Jones, D.L. (1990). *A study of the belief systems of two beginning middle school mathematics teachers*. Unpublished Doctoral Dissertation. University of Georgia, Athens.

- Kagan, D.M. (1992). Professional growth among preservice and beginning teachers. *Review of Educational Research*, 62(2), 129-169.
- Kagan, D.M., & Tippins, D.J. (1991). How teachers' classroom cases express their pedagogical beliefs. *Journal for Teacher Education*, 42(4), 281-291.
- Kaplan, R.G. (1991). Teacher beliefs and practices: A square peg in a round hole. *Proceedings of the Annual Meeting of the North American Chapter of the International Committee for the Psychology of Mathematics Education*, Blacksberg, VA.
- Katz, L.G. (1972). Developmental stages of preschool teachers. *Elementary School Journal*, 3, 50-54.
- Katz, L.G., & Rath, J. (1992). Six dilemmas in teacher education. *Journal of Teacher Education*, 43, 376-385.
- Kelly, G.A. (1955). *The psychology of personal constructs*. New York: Norton.
- Kemmis, S., & McTaggart, R. (1988). *The action research planner*. Geelong: Deakin University.
- Kemmis, S., & McTaggart, R. (1992). *The action research planner*. Geelong: Deakin University.
- Kennedy, M. (1997). The connection between research and practice. *Educational Researcher*, 26(7), 4-12.
- Knowles, M. (1980). *An Andragogical model of human resource development. The Modern Practice of Adult Education Review*. Chicago: Association Press.
- Knowles, M. (1984). *Andragogy in Action*. San Francisco: Jossey-Bass.
- Krupp, J. (1987). Mentoring: A means by which teachers become staff developers. *Journal of Staff Development*, 8(1), 12-15.
- Korthagen, F.A.J. & Kessels, J.P.A.M. (1999). Linking theory and practice: Changing the pedagogy of teacher education. *Educational Researcher*, 28(4), 4-17.
- Kuhs, T.M., & Ball, D.L. (1986). *Approaches to teaching mathematics: Mapping the domains of knowledge, skills and dispositions*. Michigan State University, Center on Teacher Education.
- LaBoskey, K. (1993). A conceptual framework for reflection in preservice teacher education. In J. Calderhead & P. Gates (Eds.) *Conceptualising reflection in teacher development*, (pp. 23-38). London: The Falmer Press.
- Lacey, C. (1977). *The socialization of teachers*. London: Methuen.
- Lampert, M. (1985). How do teachers manage to teach? *Harvard Educational Review*, 55(2), 178-194.
- Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American Educational Research Journal*, 27(1), 29-63.
- Lane, G.M. & Canosa, R. (1995). A mentoring program for beginning and veteran teachers of students with severe disabilities. *Teacher Education and Special Education*, 18(4), 230-239.
- Lapan, G. & Theule-Lubienski, S. (1994). Training teachers or educating professionals? What are the issues and how are they being resolved? In G.

Gaulin, B. Hodgson, D. Wheeler, & J. Egsgard (Eds.) *Proceedings of the 7<sup>th</sup> International Congress of Mathematics Education*, (pp. 249-261). Quebec: Les Presses de L'Universite Laval.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lerman, S. (1983). Problem solving or knowledge-centred: The influence of philosophy on mathematics teaching. *International Journal of Mathematics Education in Science and Technology*, 14(1), 56-66.

Lerman, S. (1990). The role of research in the practice of mathematics education. *For the Learning of Mathematics*, 10(2), 25-28.

Lin, H.S. (1996). Beginning teachers' and their students' conceptions of science teaching. *Proceedings of the National Science Council of the Republic of China*, (pp. 16-24). Volume 6(1).

Little, J.W. (1990). Teachers as colleagues. In A. Lieberman (Ed.), *Schools as collaborative cultures: Creating the future now*, (pp. 165-193). New York: Falmer Press.

Lokan, J., Ford, P., & Greenwood, L. (1996). *Mathematics and science on the line: Australian Junior secondary students' performance in the Third International Mathematics and Science Study*. Melbourne: Australian Council for Educational Research.

Lortie, D.C. (1975). *School Teacher*. Chicago: University of Chicago Press.

Louden, W. (1994). *Professional development to support trials of the student outcome statements*. Report No 2. Edith Cowan University.

Louden, W., & Wallace, J. (1996). *Quality in the classroom: Learning about teaching through case studies*. Rydalmere, NSW: Hodder Education.

Malone, J. (1996). *Case studies of preservice secondary mathematics teachers' beliefs: Emerging and evolving themes*. Personal communication.

Malone, J.A. (1995). Determining preservice teachers' beliefs about their role in teaching mathematics. In A. Richards (Ed.), *FLAIR - 15th biennial conference of the Australian Association of Mathematics Teachers*, (pp. 264-270). Darwin: AAMT.

Mason, J. (1994). Researching from the inside in mathematics education: Locating an I-you relationship. In J. Ponte & J. Matos (Eds.), *Proceedings of PME xviii*, (pp. 176-194). Lisbon, Portugal: University of Lisbon.

Mathematics Advisory Council, (1994). *Desirable attributes of beginning teachers* (Ministerial Report, NSW Advisory Council on Teacher Education and Quality Teaching). NSW: Author.

McDaniel, J.E. (1991). Close encounters: How do student teachers make sense of the social foundations? *Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco*.

McDiarmid, G. (1990). Challenging prospective teachers' beliefs during early field experience: A Quixotic undertaking. *Journal of Teacher Education*, 41(3), 12-20.

McIntosh, A. (1979). When will they ever learn? *Forum*, 19(3), 92-95.

- McLeod, D.B. (1992). Research on affect in mathematics education: A reconceptualisation. In D.A. Grouws (Ed.), *Handbook of Research on Mathematics Teaching and Learning*, (pp. 575-596). New York: Macmillan.
- McNergney, R.F. & Carrier, C.A. (1981). *Teacher Development*. New York: Macmillan.
- Merseth, K.K. (1996). Cases and case methods in teacher education. In J. Sikula (Ed.), *Handbook of Research on Teacher Education*, (pp. 722-744). New York: Association of Teacher Education.
- Mertz, N.T., & McNeely, S.R. (1991). Cognitive constructs of pre-service teachers: How students think about teaching before formal preparation. *Paper presented at the annual meeting of the American Educational Research Association*, Chicago: AERA.
- Miles, M. (1995). Forward. In T. Guskey & M. Huberman (Eds.) *Professional development in education: New paradigms and practices*, (pp. vii-ix). New York: Teachers College Press.
- Miles, M.B., & Huberman, A.M. (1994). *Qualitative data analysis: An expanded sourcebook* (second edition). Thousand Oaks, CA: Sage.
- Moje, E.J., & Wade, S.E. (1997). What case discussions reveal about teacher thinking. *Teacher and Teacher Education*, 13(7), 691-712.
- Morris, E. (1998). Tough love for the new boys and girls. *Times Educational Supplement*, May, p. 21.
- Mousley, J., & Clements, M.A. (1990). The culture of mathematics classrooms. In K. Clements (Ed.), *Whither Mathematics*, (pp. 397-407). Melbourne: Mathematics Association of Victoria.
- National Council of Teachers of Mathematics, (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.
- National Council of Teachers of Mathematics, (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.
- National Curriculum Corporation, (1991). *The National Curriculum and the initial training of student, articulated and licensed teachers*. London: National Curriculum Council.
- Nickson, M. (1992). The culture of the mathematics classroom: An unknown quantity. In D.A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*, (pp. 101-113). New York: Macmillan.
- Nisbet, S. (1991). A new instrument to measure pre-service primary teachers' attitudes to teaching mathematics. *Mathematics Education Research Journal*, 3(2), 34-56.
- Nolder, R. (1990). Accommodating curriculum change in mathematics: Teachers' dilemmas. In *Proceedings of the 14th Conference of the International Group for the Psychology of Mathematics Education*, (pp. 167-174). Oaxtepec, Mexico: PME.
- Odell, S.J. (1986). Induction support for new teachers: A functional approach. *Journal of Teacher Education*, Jan/Feb., 26-29.

- O'Loughlin, M. (1989). *The influence of teachers' beliefs about knowledge, teaching and learning on their pedagogy: A constructivist reconceptualisation and research agenda for teacher education*. Paper presented at the 19<sup>th</sup> annual symposium of the Jean Piaget Society, Philadelphia, PA.
- Pajares, M.F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62(3), 307-332.
- Patton, M. (1990). *Qualitative evaluation and research methods* (2<sup>nd</sup> edition). Newberry Park, CA: Sage Publications.
- Peterson, B. & Williams, S. (1998). Mentoring beginning teachers. *The Mathematics Teacher*, 91(8), 730-734.
- Perry, B., Howard, P., & Conroy, J. (1996). K-6 teacher beliefs about the learning and teaching of mathematics. In P. Clarkson (Ed.) *Technology in mathematics education, Proceedings of the 19<sup>th</sup> Annual Conference of the Mathematics Education Research Group of Australasia*, (pp. 453-460). Melbourne: MERGA.
- Pierce, D., & Hunsaker, T.W. (1996). Professional development for the teacher, of the teacher and by the teacher. *Education*, 117(1), 101-105.
- Pollard, A., & Tann, S. (1987). *Reflective Teaching in the Primary school*. London: Cassell Educational.
- Prawat, R. (1991). Conversations with self and settings: A framework for thinking about teacher empowerment. *American Educational Research Journal*, 28(4), 737-757.
- Prawat, R. (1992a). Are changes in views about mathematics teaching sufficient? The case of a Fifth grade teacher. *The Elementary School Journal*, 93(2), 195-211.
- Prawat, R.S. (1992b). Teachers' beliefs about teaching and learning: A constructivist perspective. *American Journal of Education*, 100(3), 354-395.
- Pultorak, E. (1996). Following the developmental process of reflection in novice teachers: Three years of investigation. *Journal of Teacher Education*, 47(4), 283-291.
- Qualitative Solutions and Research (1997). *NUD\*IST* [Computer software]. Melbourne: Author.
- Raymond, A. (1997). Inconsistency between a beginning elementary teacher's mathematics belief and teaching practice. *Journal for Research on Mathematics Education*, 28(5), 550-576.
- Raymond, A., & Santos, V. (1995). Preservice elementary teachers' self reflection: How innovation in mathematics teacher preparation challenges mathematics beliefs. *Journal of Teacher Education*, 46(1), 58-70.
- Reeves, N. (1990). Action research for professional development. In L.P. Steffe & T. Wood (Eds.) *Transforming children's mathematics education*, (pp. 436-447). Hillsdale, NJ: LEA.
- Relich, J., & Way, J. (1992). Pre-service primary teachers' attitudes to teaching mathematics. A reappraisal of a recently developed instrument. In B. Southwell, B. Perry, & K. Owens (Eds.), *Space, the first and final frontier. 15th Annual Conference of the Mathematics Education Research Group of Australasia*, (pp. 460-470). Richmond, NSW: MERGA.

- Relich, J., & Way, J. (1994). Attitudes to teaching mathematics. The development of an attitudes questionnaire. In G. Bell, B. Wright, N. Leeson, & J. Geake (Eds.), *Challenges in mathematics education: Constraints on construction. 17th Annual Conference of the Mathematics Education Research Group of Australasia*, (pp. 276-283). Lismore, NSW: MERGA.
- Relich, J., Way, J., & Martin, A. (1994). Attitudes to teaching mathematics: Further development of a measurement instrument. *Mathematics Education Research Journal*, 6(1), 56-69.
- Reynolds, A. (1992). What is competent beginning teaching? A review of the literature. *Review of Educational Research*, 62(1), 1-35.
- Reynolds, A. (1995). The knowledge base of beginning teachers: Education professionals' expectations versus research findings on learning to teach. *The Elementary School Journal*, 95, 199-221.
- Richardson, V. (1990). Significant and worthwhile change in teaching practice. *Educational Researcher*, 19(7), 10-18.
- Richardson, V. (1994). Conducting research on practice. *Educational Research*, 23(5), 5-10.
- Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula, T.J. Buttery, E. Guyton (Eds.), *Handbook of Research on Teacher Education*, (pp. 102-119). New York: Macmillan.
- Robinson, I. (1989). The empowerment paradigm for the professional development of teachers of mathematics. In N.F. Ellerton & M.A. Clements (Eds.), *School mathematics: The challenge of change*, (pp. 269-283). Geelong, Victoria: Deakin University.
- Romberg, T.A., & Carpenter, T.P. (1986). Research on teaching and learning mathematics: Two disciplines of scientific enquiry. In M.C. Wittrock (Ed.), *Handbook on Research on Teaching*, (pp. 850-873). New York: Macmillan.
- Rosenberg, M.S., Griffin, R.C., Kilgore, K.L. & Carpenter, S.L. (1997). Beginning teachers in special education: A model for providing individual support. *Teacher Education and Special Education*, 20(4), 301-321.
- Rust, F. (1994). The first year of teaching: It's not what they expected. *Teacher and Teacher Education*, 10(2), 205-217.
- Ryan, K. (1974). *Survival is not good enough: Overcoming the problems of beginning teachers*. Washington, DC: American Federation of Teachers.
- Ryan, K. (1986). The induction of new teachers. Bloomington: Phi Delta Kappa Educational Foundation.
- Schofield, J.W. (1990). Increasing the generalisability of qualitative research. In E. Eisner & A. Peshkin (Eds.), *Qualitative enquiry in education: The continuing debate*, (pp. 201-232). New York: Teachers College Press.
- Schon, D.A. (1983). *The reflective practitioner*. New York: Basic Books.
- Schram, P., Wilcox, S., Lappan, G., & Lanier, P. (1989). Changing preservice teachers' beliefs about mathematics education. In C. Maher, G. Goldin, & R. Davis (Eds.), *Proceedings of the 11<sup>th</sup> annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. New Brunswick, NJ: Rutgers University.



- Shulman, J.H. (1991). Revealing the mystery of teacher-written cases: Opening the black box. *Journal of Teacher Education*, 42(4), 250-262.
- Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15, 1-22.
- Shulman, L.S. (1998). Theory, practice and the education of professionals. *The Elementary School Journal*, 98(5), 511-526.
- Shulman, L.S., & Grossman, P.L. (1988). *Knowledge growth in teaching: A final report to the Spencer foundation*. Stanford, CA: Stanford University.
- Sigel, I. (1985). A conceptual analysis of beliefs. In I. Sigel (Ed.), *Parental belief systems: The psychological consequences for children*. Hillsdale, NJ: Erlbaum.
- Simon, M. (1994). Learning mathematics and learning to teach: Learning cycles in mathematics teacher education. *Educational Studies in Mathematics*, 26, 71-94.
- Simon, S., & Brown, M. (1996). Teacher beliefs and practices in primary mathematics. *Paper presented at the 20<sup>th</sup> meeting of the Psychology of Mathematics Education*, Valencia.
- Skemp, R. (1976). Relational and instrumental understanding. *Mathematics Teaching*, 77, 20-26.
- Smyth, J. (1989a). A critical pedagogy of classroom practice. *Journal of Curriculum Studies*, 21(6), 483-502.
- Smyth, J. (1989b). Developing and sustaining critical reflection in teacher education. *Journal of Teacher Education*, 40(2), 2-9.
- Southwell, B. (1993). Reflection and beliefs in mathematics education—Past, present and future. In A. Herrington (Ed.), *New horizons, New challenges*, (pp. 291-298). Perth: Australian Association of Mathematics Teachers.
- Southwell, B., & Khamis, S. (1991). Beliefs about mathematics and mathematics education. *Paper presented at Australian Association for Research in Education Conference*. Gold Coast, Queensland.
- Sparrow, L., & Herrington, T. (1993). Enhancing the quality of mathematics learning and teaching through action research. In S. Groves & R. Tytler (Eds.), *Contemporary approaches to research in mathematics education*, (pp. 152-155). Geelong, Victoria: Deakin University.
- Sparrow, L., & McIntosh, A. (1998). Teachers building number sense amid the challenges of change. In C. Kanes, M. Goos, & E. Warren (Eds.), *Teaching Mathematics in New Times*, (pp. 532-540). Brisbane, QLD: MERGA.
- Sparrow, L., & Swan, P. (1997). *Calculator use in Western Australian primary schools*. Perth: MASTEC.
- Speck, M. (1996). *Best practice in professional development for sustained educational change*. ERS Spectrum.
- Steen, L. (1988). The science of patterns. *Science*, 240, 611-616.
- Stodolsky, S. (1989). *The subject matters*. Chicago: University of Chicago Press.
- Sullivan, P. (1989a). Factors inhibiting change—A case study of a beginning primary teacher. *Mathematics Education Research Journal*, 1(2), 1-16.

- Sullivan, P. (1989b). *An investigation into the impact of a preservice teacher education and other professional support on classroom practice of primary teachers*. Unpublished Doctoral Dissertation, Monash University.
- Tabachnick, B.R., & Zeichner, K. (1984). The impact of the student teacher experience on the development of teacher perspectives. *Journal of Teacher Education*, 35(6), 28-36.
- Taylor, P.C. (1996). Mythmaking and mythbreaking in the mathematics classroom. *Educational Studies in Mathematics*, 31, 151-173.
- Thompson, A.G. (1984). The relationship of teachers' conceptions of mathematics and mathematics teaching to instructional practice. *Educational Studies in Mathematics*, 15, 105-127.
- Thompson, A.G. (1992). Teachers' beliefs and conceptions: A synthesis of research. In D.A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*, (pp. 127-145). New York: Macmillan.
- Treagust, D., Duit, R. & Fraser, B. (1996). *Improving Teaching and Learning in Science and Mathematics*. New York: Teachers College Press.
- Tripp, D. (1993). *Critical incidents in teaching: Developing professional judgement*. London: Routledge.
- Tyson, P., Barnett, C., & Gordon, A. (1995). *From teacher to students and back again: Evaluating math case teacher professional development based on student thinking and interactions*. Personal Communication .
- Underhill, R.G. (1988). Mathematics learners' beliefs: A review. *Focus on Learning Problems in Mathematics*, 10, 56-69.
- Underhill, R.G. (1991). Two layers of constructivist curricular interaction. In E. von Glasersfeld (Ed.), *Radical Constructivism in mathematics education*, (pp. 229-248). Dordrecht: Kluwer.
- Van Manen, M. (1990). Beyond assumptions: Shifting the limits of action research. *Theory into Practice*, xxiix(3), 152-157.
- Varah, L.J., Theune, W.S., & Parker, L. (1986). Beginning teachers: Sink or swim. *Journal of Teacher Education*, Jan/Feb., 30-34.
- Van Zoest, L.R., Jones, G.A., & Thornton, C.A. (1994). Beliefs about mathematics teaching held by preservice teachers involved in a first grade mentorship program. *Mathematics Education Research Journal*, 6(1), 37-55.
- Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research*, 54(2), 143-178.
- Von Glasersfeld, E. (1988). The reluctance to change a way of thinking. *The Irish Journal of Psychology*, 9(1), 83-90.
- Von Glasersfeld, E. (1995). *Radical Constructivism: A way of knowing and learning*. London: Falmer Press.
- Vonk, J. (1989). *Becoming a teacher: Brace yourself*. Unpublished paper, Amsterdam: Vrije University.
- Way, J. (1996). Constructivism, integration and teaching mathematics. In P. Clarkson (Ed.), *Technology in Mathematics Education. Proceedings of the 19<sup>th</sup> Annual*

*Conference of the Mathematics Education Research Group of Australasia*, (pp. 177-186). Melbourne: MERGA.

- Weinstein, C.S. (1988). Preservice teachers' expectations about the first year of teaching. *Teaching and Teacher Education*, 4(1), 31-40.
- Weinstein, C.S. (1990). Prospective elementary teachers' beliefs about teaching: Implications for teacher education. *Teaching and Teacher Education*, 6(3), 279-290.
- Weinstein, C.S. (1998). I want to be nice, but I have to be mean: Exploring prospective teachers' conceptions of caring and order. *Teaching and Teacher Education*, 14(2), 153-163).
- Wideen, M., Mayer-Smith, J., & Moon, B. (1998). A critical analysis of the research on learning to teach: Making a case for an ecological perspective on inquiry. *Review of Educational Research*, 68(2), 130-178.
- Wilcox, S., Lanier, P., Schram, P., & Lappan, G. (1992). *Influencing beginning teachers' practice in mathematics education: Confronting constraints of knowledge, beliefs and context* (No. 92-1). National Center for Research on Teacher Learning, Michigan State University.
- Wilcox, S., Schram, P., Lappan, G., & Lanier, P. (1991). The role of a learning community in changing preservice teachers' knowledge and beliefs about mathematics education. *For the Learning of Mathematics*, 11(3), 31-39.
- Wilson, S. (1992). A case concerning content: Using case studies to teach subject matter. In J.H. Shulman (Ed.), *Case methods in teacher education*, (pp. 64-89). New York: Teachers College Press.
- Zeichner, K. (1983). Alternative paradigms of teacher education. *Journal of Teacher Education*, 34, 3-9.
- Zeichner, K., & Gore, J.M. (1990). Teacher socialization. In W.R. Houston (Ed.), *Handbook of Research on Teacher Education*, (pp. 329-348). New York: Macmillan.



# **Appendix 1**

## **Interview Schedule**

## Appendix 1

### Interview Schedule

	Stephanie	Tiffany	Harry	Gaz	Patrick
Term One	17th Feb. ST1		21st Feb H1		
	26th Feb ST2		26th Feb H2		
	24th March ST3	13th March T1	26th March H3	5th March G1	12th March P1
				9th April G2 (cancelled)	
Term Two	14th May ST4	30th April T2	21st May H4	7th May G3	1st May P2
	26th June ST5	11th June T3		18th June G4	12th May P3
					25th June P4 (cancelled)
Term Three	27th August ST6	26th August T4	26th August H5		6th August (no response)
31st August Case methods meeting	16th Sept. ST7	8th Sept. T5	2nd Sept H6	3rd Sept G5	
				17th Sept G6 (cancelled)	
Term Four	6th Nov ST8	28th Oct T6	12th Nov H7		
8th Nov. case methods meeting	27th Nov. ST9	3rd Dec T7	25th Nov H8		

**Appendix 2**  
**Consent and information forms for Study**

## Consent form for participants

### Supporting Beginning Teachers to teach mathematics

I ----- have been informed about all aspects of the above research project and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realising I may withdraw at any time.

I agree that the research data gathered for this study may be published provided I am not identifiable.

Participant

Date

Investigator

Date



Dear

### Supporting beginning teachers to teach mathematics

The proposed project, which I hope you will agree to join, is concerned with supporting beginning teachers in their first year of teaching mathematics in the primary school. The data gathered will contribute to my Ph.D in mathematics education.

If you join the project, which will take place during your first year as a teacher, I would hope to:

- meet with you in school during the year at intervals of approximately a fortnight,
- discuss with you issues which arise,
- ask you to keep a reflective journal,
- join with others for meetings approximately twice a term.

You will not be identifiable from the data and report of the project as code names will be used. On no occasions in any published material will you be referred to by your own name.

All data will be kept securely, will not be used for any other purpose without your consent and will be destroyed at the end of the project.

Your participation in the study is of a voluntary nature and should you wish you may withdraw at any stage without penalty.

Please contact me at Edith Cowan University, Department of Mathematics Education, Churchlands, WA 6018, or telephone me 273-8347 if you have any questions or difficulties related to the project.

Thank you

Yours Sincerely,

## **Appendix 3**

### **Guidance for writing journals**

# Supporting beginning teachers to teach mathematics

## Journals and Narratives

On further reflection I felt that I had not been clear enough about the use of journals and narratives. These two techniques will be a major part of my data gathering and also vehicles for the development of the support project.

My thoughts are as follows:

### Journal

As I mentioned this will be available only to you and me and the data/contents will be treated as confidential. I would like to think that you could find time to add to it at least once a week. Typically it could contain your thoughts, reflections and comments on

- the mathematics you have taught in the week,
- the successes, problems and frustrations,
- any limitations or constraints you felt,
- reactions of the children,
- reactions from the school and community,
- best and worst events of the week,
- anything else you wish to add.

Please date each entry.

### Narrative

This is a shortish report or story of an incident which happened in your teaching of mathematics. It could be a story of a situation which gave success or problems that occurred and your reaction to them. Over the year you will document a number of such stories. These will form the basis of our discussions and the case methods meetings.

At the moment I have not managed to obtain funds to buy the small tape recorders. If you have your own recorder please use it if you wish for your journal and narratives. Otherwise handwriting or word processing will be sufficient. I can supply ordinary audio tapes - again don't forget to put on the date ( e.g. Captain's Log Star Date 57.34)

# Supporting Beginning Teachers Project

## More thoughts

### Narratives

I'm hoping to collect some of these from you. I suggest you just add them to your journal tape. Just note a date for each so I can find some sort of sequence for them.

Write/talk about experiences/incidents of teaching mathematics with your class. An incident that was successful or unsuccessful or puzzled or disappointed you or surprised you.

### Post Meeting

Again (sorry if this is becoming too large) some thoughts and reflections based on the case methods meeting. Below are some starters but feel free to ignore some or all of them and to add your own:

- What thoughts and insights did the discussion trigger in you?
- What things, for you, were unresolved?
- What did you learn from the discussion?
- What was positive, negative or of interest about the discussion?
- What ideas and practices has the case discussion validated or confirmed for you?
- What ideas or practices has the discussion led you to question or see differently?

## Interview questions

It's week 3 of the term, how are you settling in to the school and classroom?

What is your degree specialism and other background qualifications?

What have you already taught in mathematics?

What do you expect to teach soon?

Tell me about the successes you've had

How have the education department supported you in your move into the classroom?

What support from the school in general and also specifically in mathematics?

What do you think are the expectations of the school related to you in general and to mathematics in particular?

What constraints do you feel there are?

What difficulties do you feel there are with regard to mathematics teaching?

What aspect of your mathematics teaching do you want to consider first?

---

Extra questions from reading Bullough (1990)

What are your teaching ideals?

What would you like the other staff to comment on in the staff-room about your teaching?

How did you plan for your first few weeks in school?  
What actually happened?

Did you have any concerns about starting your new job?

How did you prepare for the new job?

What was your first week/term like?

**Appendix 4**  
**Acknowledgement of attendance**



EDITH COWAN  
UNIVERSITY

PERTH WESTERN AUSTRALIA

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Department of Mathematics Education,  
Pearson Street,  
Churchlands,  
W.A. 6018

4th September 1997

This note is to acknowledge the presence and participation of

at a Professional Development morning for mathematics education.  
Edith Cowan University, Saturday, 30th August 1997

R. L. Sparrow

Lecturer in Primary Mathematics Education



# EDITH COWAN UNIVERSITY

PERTH WESTERN AUSTRALIA

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Department of Mathematics Education,  
Pearson Street,  
Churchlands,  
W.A. 6018

13th November 1997

This note is to acknowledge the presence and participation of

at a Professional Development meeting (10:00 to 11:30) for the project  
Supporting Beginning Teachers to teach mathematics.  
Edith Cowan University, Saturday, 8th November 1997.

R. L. Sparrow

Lecturer in Mathematics Education.





EDITH COWAN  
UNIVERSITY

PERTH WESTERN AUSTRALIA

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Department of Mathematics Education,  
Pearson Street,  
Churchlands,  
W.A. 6018

9th December 1997

This note is to acknowledge the presence and participation of

at Professional Development meetings for the project

Supporting Beginning Teachers to teach mathematics.

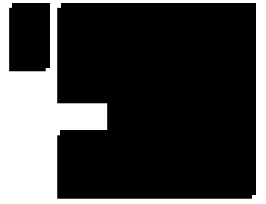
Meetings took place over the four terms of 1997 and constituted 12 hours of  
Preofessional Development in mathematics education.

R. L. Sparrow

Lecturer in Mathematics Education.

## **Appendix 5**

### **General letters to Participants**



It seems almost unreal that it is already half way through the teaching year. I have now slightly less than two school terms to collect the rest of the data for my project which is somewhat scary.

I hope you are well rested after your break and ready for the new term. Minor note for interested parties, I, of course, have not had any leave and have been working hard throughout the time! Even for the week in New Zealand was completely devoted to work.

With regard to the project, I'm hoping to achieve a number of things this term. Firstly I would like to set dates for a couple of visits to you. During one, as I mentioned to most of you, I would like to observe one of your mathematics lessons. This is not a tutor evaluative session! I would just like to document exactly what happens with no evaluative comment. After that I would like to have a brief chat and set up the next action research cycle with you. The second visit would be later in the term and would be part of the cycle of reflection, in a similar style to what has already happened. As far as I know my timetable for this semester Wednesday seems to be the best option, though Tuesday and Thursday afternoons are also possibilities. May I suggest the following:

Secondly I hope to prevail on you for a group meeting. I've mentioned this to most of you and it seems that the idea of meeting for approximately an hour on a Saturday is appropriate. May I suggest a tentative date of

You can then dash off to Coles to do the weekend shopping. Please let me know if this is a possibility.

Part of my work back at the Uni is to start analysing the data. I'm somewhat anxious to begin this process and need some of the data from you. Could you please send to me or give to me on one of my visits:

- the journal tapes and written journals so far,
- notes of any "stories" or critical incidents if they are recorded in another form from the journal,

- your mathematics planning for term 1 and term 2. I'll copy this and return it to you in the next post.
- your thoughts as to how you feel you have changed/developed as a teacher of primary mathematics over the first two terms. How are you different now? What have you learned or realised? What do you do now that you did or didn't do then? You can talk this straight into the tape if you wish and I'll transcribe it. By the way I propose to show you all the notes of meetings and tape transcriptions etc for your comment as to their accuracy.

That should be enough to keep me going for a while.

Department of Mathematics Education,  
Edith Cowan University,  
Pearson Street,  
Churchlands, WA 6018.

8th October 1997

Well by now you should be back at school and ready to face the next and last term of the year. I managed four days leave and have also read my research proposal again.

With your help I would like to finish the data gathering before the end of the term. To that end I have a number of requests which I hope will not prove to be too onerous.

Some dates to arrange and one to confirm:

Saturday 8th November. Another case meeting at Churchlands.  
Staff room for 10 o'clock

Two visits to you in school. Please confirm with me the following:

Visit 1

Visit 2

I would also like to obtain the following documents:

- Photocopies of your mathematics programmes for the four terms (assuming I don't already have them).
- Your journal talking/entry. Please also return the tape recorders as I need to use them on another project.
- At least two stories of something that happened in mathematics.
- Children's thoughts about what is good mathematics and what is a good mathematics teacher.



# EDITH COWAN UNIVERSITY

PERTH WESTERN AUSTRALIA

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Department of Mathematics Education,  
Pearson Street,  
Churchlands,  
W.A. 6018

9th December 1997

Well the last of the data has been collected. There will be no more strange questions or things to compare. Thanks very much for your help. I really do appreciate the time and effort you have given during the strenuous first year out.

Before I finish, however, I need to tie up a few loose ends.

- and        have a hand held tape recorder each. I need to return these to media before the end of semester (Dec. 19Th). Please send them to me soonest.
- and        are completing a couple of final surveys. Please send them to me before you lose them in the final tidy.
- If you have anything else of interest—part journals, children's reactions etc please also send them.

For those people who requested it there should be a separate note relating to PD hours with this letter. If anyone else requires something like that or a letter to their Principal please let me know.

Best wishes for Christmas and the New Year.

## **Appendix 6**

### **Journal Schedule**

**Journal Schedule**

<b>Stephanie</b>	<b>Tiffany</b>	<b>Harry</b>	<b>Gaz</b>
	<b>T1</b> <b>14<sup>th</sup> March</b>	<b>H1</b> <b>End of Term 2</b>	<b>G1</b> <b>14<sup>th</sup> February</b>
	<b>T2</b> <b>3<sup>rd</sup> April</b>	<b>H2</b> <b>Start Term 3</b>	<b>G2</b> <b>21<sup>st</sup> February</b>
	<b>T3</b> <b>28<sup>th</sup> April</b>	<b>H4</b> <b>Week 1 Term 3</b>	<b>G3</b> <b>28<sup>th</sup> February</b>
	<b>T4</b> <b>15<sup>th</sup> May</b>	<b>H5</b> <b>Week 2 Term 3</b>	<b>G4</b> <b>7<sup>th</sup> March</b>
	<b>T5</b> <b>4<sup>th</sup> June</b>	<b>H6</b> <b>Weeks 3&amp;4</b> <b>Term 3</b>	<b>G5</b> <b>14<sup>th</sup> March</b>
	<b>T6</b> <b>End of Term 2</b>	<b>H7</b> <b>Week 5 Term 3</b>	<b>G6</b> <b>21<sup>st</sup> March</b>
	<b>T7</b> <b>24 July</b>		<b>G7</b> <b>4<sup>th</sup> April</b>
	<b>T8</b> <b>6 August</b>		<b>G8</b> <b>4<sup>th</sup> April</b>
	<b>T9</b> <b>November</b>		<b>G9</b> <b>11<sup>th</sup> April</b>
			<b>G10</b> <b>2<sup>nd</sup> May</b>